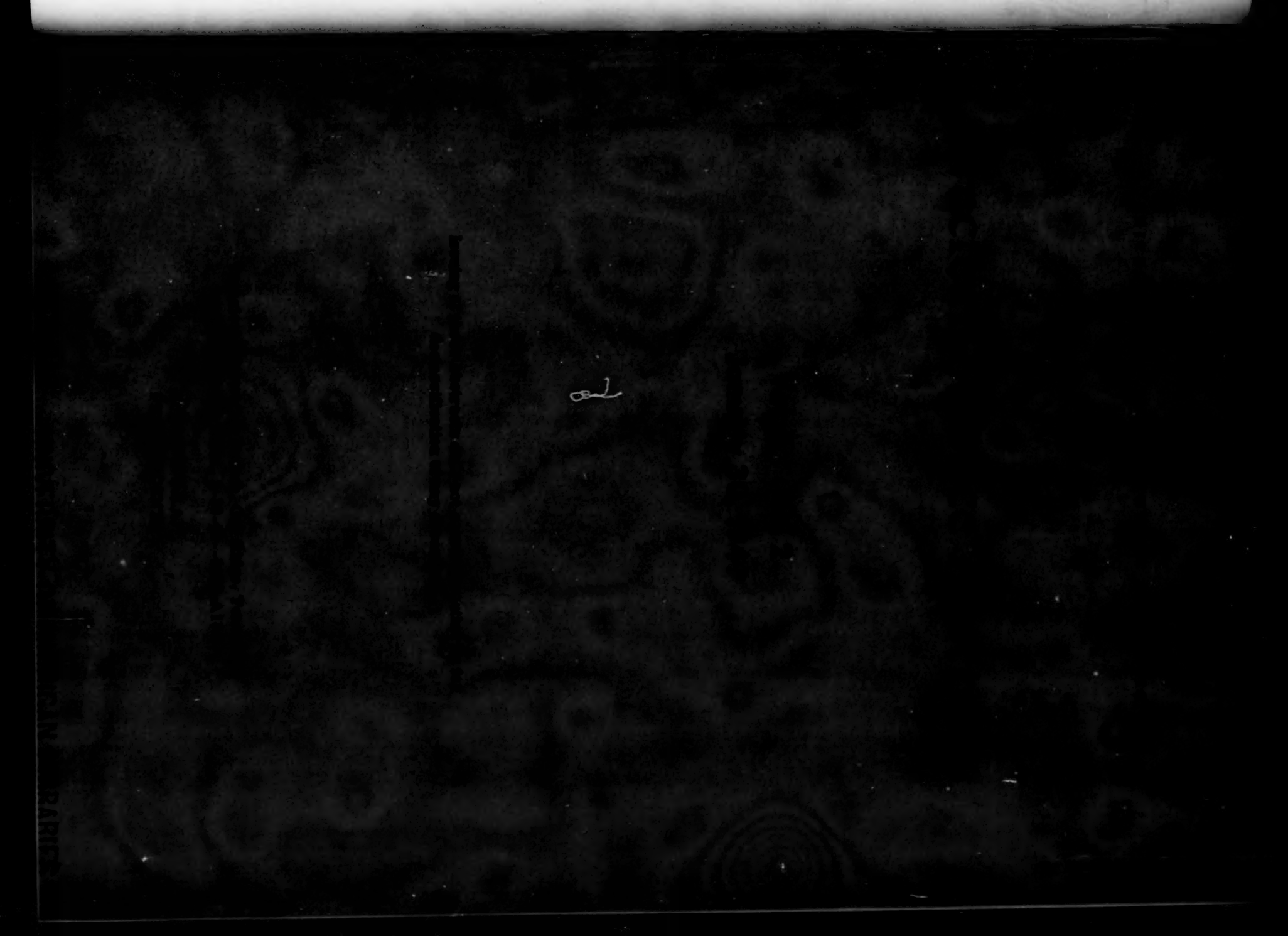

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ABSORPTION AND SCATTERING OF RADIATION

372 Monte Carlo Calculations for Shields by Wendell De Marcus and Lewis Nelson. AECU-47 (NEPA-860) Dec 30 1948 11p

The problems of neutron and gamma ray attenuation in thick shields have declined to capitulate when attacked by purely analytical means. To be enabled to actually predict the attenuations in thick shields, a number of workers in this field have felt that it is necessary to turn to a type of calculation which is aptly entitled the Monte Carlo method. Accepting for the moment, the non-feasibility of analytical calculations for neutron attenuations, a solution would seem to be as follows. The investigator would make up various sets of roulette wheels with the fractional periphery of the wheel which is colored a given color, proportional to the macroscopic cross section corresponding to a given element and a given neutron energy. Obviously, there would have to be a number of these wheels corresponding to the different energies at which one evaluated the cross sections. Another set of spinners would be marked off such that the pockets for the ball bore numbers chosen in such a fashion that the number of pockets with numbers between a and b would be proportional to the relative number of times a neutron of the given energy would transverse a path whose length was between a and b. Still another set of wheels would be marked off to choose the angle between direction of a neutron before collision and after collision, each wheel being weighted to simulate the angular distribution of neutrons corresponding to a given type of collision. For all types of collision one wheel would suffice to choose the azimuthal angle ϕ completely at random. The problem of neutron attenuation in thick shields could then in principle be solved by a statistical approach. There is unfortunately a serious drawback to this method. Certainly one operator could never do enough neutrons to enable him to compute results in shields with large attenuations. It is therefore desirable that the roulette wheels and the calculator be combined into a high speed computing machine. However, when the problem is set up in terms of a machine, it does not entirely eliminate the above difficulty. Further discussion of methods is included.

373 Experimental Determinations of Stopping Powers Using Alpha Particles of 15 to 37 Mev by E L Kelly. AECU-54 (UCRL-208) Nov 10 1948 8p

An experimental determination of the relative stopping power of various elements was undertaken using the alpha particle beam of the Crocker 60" cyclotron. Aluminum was used as a standard of comparison. Copper, silver, tantalum, bismuth, and thorium were investigated. The stopping power was determined in the following way. The range of the alpha beam in aluminum was first determined. An absorber of the element to be investigated was placed in the path of the alpha beam, reducing the energy of the emergent alpha particles. Then the range in aluminum of the reduced energy alphas was determined. The difference in the two measured ranges in aluminum represents the thickness of aluminum absorber which would produce the same energy loss (at the alpha particle energy used) as would the absorber under investigation. This procedure was carried out at two alpha particle energies, approximately 28 Mev and 37 Mev. The results are summarized in tabular form.

374 The Absorption Coefficient of the β Rays from $^{35}_{16}S$ in Aluminium by C H Collie and M A Grace Proc Phys Soc 61 485-486 (1948) Nov 1 (Letter to the editor)

The absorption coefficient of the β-rays from S^{35} in aluminum has been determined experimentally and may be of use to workers using counters with cylindrical symmetry. The measurements were made with a demountable counter similar to that used previously by Collie and Morgan (J Sci Instruments 16 369 (1939)). The active barium sulfate was distributed as an even film of mean weight less than 1/10 mg/cm^2 on the inside of a movable glass cylinder. The aluminum foil absorber was wrapped around the perforated cathode of the counter and unwrapped layer by layer. From the absorption curve obtained, the absorption was found to be exponential with a coefficient of 780 ± 25 cm^{-1}, which is in agreement with the results obtained by Hendricks et al (J Phys Chem 47 469 (1943)).

375 The Absorption of Gamma-Radiation by Clyde L Cowan Phys Rev 74 1841-1845 (1948) Dec 15

Absorption coefficients for gamma radiation in the 0.32-2.8 Mev range have been determined

ABSORPTION AND SCATTERING OF RADIATION (continued)

for 5 elements distributed over a wide range in Z, i.e., Pb, Sn, Cu, Al, C, using the following sources: Cr^{51}, Cs^{137}, Zn^{65}, Sb^{124}, and Na^{24}. A geometry was employed which limited the accuracy of the results only insofar as the statistics and background corrections were concerned. Diagrams of the out-of-doors suspension (25 feet above ground), the absorption tray, and the weatherproof Geiger tube which were used are shown. The data obtained show excellent agreement when compared with the theoretical curves.

376 The Absorption of High Energy Quanta. I by G D Adams Phys Rev 74 1707-1711 (1948) Dec 1

The absorption of quanta between 11 and 20 Mev has been measured with the x-rays from the 22-Mev betatron as a source. The high energy tip of the x-ray spectrum has been isolated for these measurements by using a threshold detector method. The detectors used were copper, iron, and carbon, with which absorption coefficient values were obtained at 11.04, 13.73, and 19.10 Mev, respectively. Aluminum, iron, copper, and lead were used as absorbers. The observed absorption coefficients are in good agreement with existing theory except in the case of lead. The absorption in lead is smaller than predicted. This is probably due to the failure of the Born approximation in the calculation of the pair-production cross section.

377 The Angular Distribution of 1 to 3.5 Mev Deuterons Scattered by Deuterons by J Morris Blair, George Freier, Eugene Lampi, William Sleator Jr and J H Williams Phys Rev 74 1594-1598 (1948) Dec 1

Using the same apparatus and method as that used for previous proton-proton scattering work (Phys Rev 74 553 (1948)), the differential cross section for the elastic scattering of deuterons by deuterons has been obtained in the 1-3.5 Mev energy range. Tabulated data and a curve are shown which give the D-D scattering cross section per unit solid angle as a function of deuteron energy and of scattering angle. In addition, the D-D and P-P scattering cross sections as a function of scattering angle are compared in a center of mass system for 3 Mev deuterons and protons. The observed yields were corrected for the counted particles produced in the D-D reactions and for those scattered by contaminants by using the results of other experiments. The resultant elastic cross sections are probably accurate to about 2.5 per cent.

378 The Angular Distributions of the Products of the D-D Reaction: 1 to 3.5 Mev by J Morris Blair, George Freier, Eugene Lampi, William Sleator Jr and J H Williams Phys Rev 74 1599-1603 (1948) Dec 1

Cross sections per unit solid angle for the reactions $H^2 + H^2 \rightarrow He^3 + n$ and $H^2 + H^2 \rightarrow H^1 + H^3$ have been measured at various angles for incident deuterons of energies from 1 to 3.5 Mev. The dependence of the cross sections on angle is nearly the same for the two reactions, and it can be represented by an expression of the form $A(1 + B \cos^2\phi + C \cos^4\phi)$, where ϕ is the angle of observation in the center of mass coordinate system. A increases from 4×10^{-27} cm^2 at 1 Mev to 6×10^{-27} cm^2 at 3.5 Mev; B decreases from approximately 1 at 1 Mev to -3.5 at 3.5 Mev; C increases from 1.5 at 1 Mev to 7 at 3.5 Mev. The total cross sections for the two reactions are approximately constant at 10^{-25} cm^2 throughout this energy range.

379 Broad and Narrow Beam Attenuation of 500- to 1,400-Kv. X-Rays in Lead and Concrete by Harold O Wycoff, R J Kennedy and W R Bradford Radiology 51 849-859 (1948) Dec

This article appeared in Nucleonics 5 62-70 (1948) Nov and was abstracted in this journal as abstract No. 2-6.

ABSORPTION AND SCATTERING OF RADIATION (continued)

380 The Coulomb Scattering of Relativistic Electrons by Nuclei by William A McKinley and Herman Feshbach Phys Rev 74 1759-1763 (1948) Dec 15

An expression for the cross section for the Coulomb scattering of relativistic electrons by atomic nuclei has been evaluated. The exact results obtained by Mott (Proc of the Roy Soc 124A 426 (1929); 135A 429 (1932)) have been expanded in a power series in Z/137, where Z is the nuclear charge. The coefficients which depend principally on the angle of scattering, have been evaluated numerically using the resultant cross sections together with those evaluated previously by Bartlett and Watson for Hg (Proc Amer Acad Arts and Sciences 74 53 (1940)). The cross section for all Z-values has been obtained to within 1% accuracy. A new approximate formula valid for $Z/137 < 0.2$ is given.

381 The Efficiency of Radiation Shields by A E De Barr Rev Sci Instruments 19 922 (1948) Dec

The author adds a note with reference to a recent paper by Garrison and Lawson (Rev Sci Instruments 19 574 (1948)) in which in referring to the author's previous paper (Rev Sci Instruments 19 569 (1948)), they state this his results are applicable only when the original source of the radiation is a black body and the shields reflect in a perfectly diffuse manner. De Barr's formulas apply to the shielding of a body of any emissivity. It is noted that Garrison and Lawson's Eq. (13) is identical with Eq. (21) of the author's when the former is expanded.

382 Energy Straggling of Protons by C B Madsen and P Venkateswarlu Phys Rev 74 1782-1784 (1948) Dec 15

The energy straggling of protons of different energies penetrating foils of mica or beryllium of different thicknesses has been measured using the resonance radiation from aluminum and fluorine targets as energy indicators. The experimental results, which are tabulated, are in good agreement with the theory of straggling.

383 Experimental Determination of Rate of Energy Loss for Slow H^1, H^2, He^4, Li^6 Nuclei in Au and Al by Howard A Wilcox Phys Rev 74 1743-1754 (1948) Dec 15

A description is given of the use of a variable energy source of monoenergetic H^1, H^2, He^4, Li^6 nuclei, an energy analyzer, and an electron multiplier tube to measure the decrease in energy of these particles as they pass through a Au foil of known thickness; the measurements are carried out for protons from an energy of 30 Kev to 400 Kev, for deuterons from 30 Kev to 650 Kev, for α-particles from 30 Kev to 1400 Kev, and for the Li^6 nuclei from 750 Kev to 850 Kev. Similar measurements are carried out for the energy loss of protons and deuterons in Al over the energy range from 60 Kev to 300 Kev. Integrated range-energy curves are given for these low energies. Although current theory predicts that the energy loss rates will be precisely equal for protons and deuterons of the same velocity, it is found that the loss rate for deuterons of low velocity is a few percent higher than that for protons of the same velocity. This is explained qualitatively in terms of the "glancing" or "hard-sphere" elastic atomic collisions which are ordinarily neglected; such losses become relatively more important for low velocity particles, and a deuteron loses about four times as much energy in a glancing collision, as does a proton of the same velocity.

384 On the Theory of Energy Transfers During Collisions III (K Teorii Peredachi Energii pri Stolknoveniyakh. III) by L Landau and E Lifshitz Zhur Eksptl i Teoret Fiz 18 750-758 (1948) Aug (In Russian)

An exact method is given for a calculation of the effective cross section of the splitting up of a deuteron when crossing the Coulomb field of a nucleus. In previous works (Landau, Soviet Phys 1 88 (1932); Lifshitz, Zhur Eksptl i Teoret Fiz 8 930 (1938)) the authors studied the different processes occurring at the collisions between deuterons and heavy nuclei, such as (d,pn), (d,p), (d,n), or a capture of the deuteron by the nucleus; however, the methods suggested showed only the trend of the cross-section curves, not the absolute values. The new method, as developed in the present article, is applied

ABSORPTION AND SCATTERING OF RADIATION (continued)

only to the case (d,pn); the results give the distribution of emitted particles according to their energies and angular dispersion. The mathematical exposition starts with the setting up of a Schroedinger equation of the process under consideration, with the subsequent deduction of the d σ formula; the latter includes an integral containing wave functions of the movement of a proton and a neutron in a Coulomb field; this integral is evaluated, and the final cross section formula established. Since direct experimental data on the reaction studied are lacking, a comparison is made between the calculated cross sections for (d,pn) and the values given by Tatel and Cork (Phys Rev 71 p 159 (1947)) for Bi^{209} (d,p) RaE^{210}, and Bi^{209} (d,n) Po^{210}, (the quantities measured were the activities of RaE and Po, thus leaving the reaction Bi^{209} (d,pn) unrecorded):

E (Mev)	$\sigma_{d,p}$	$\sigma_{d,n}$	$\sigma_{d,np}$	($\times 10^{28}$ cm^2)
8.2	18	3.4	170	
6.3	1.5	0.12	10	

This result suggests the predominance of the reaction (d,np).

385 Statistical Error in Absorption Experiments by M E Rose and M M Shapiro Phys Rev 74 1853-1864 (1948) Dec 15

This article is based on AECD-2197. An abstract of this document has been listed in Nuclear Science Abstracts as Abstract No. I-991.

386 A Study of the Energy Distribution of Scattered X-Radiation by Hirendra Kumar Pal Indian J Phys 22 291-304 (1948) July

The intensity distribution of x-radiation scattered from various substances has been investigated using heterogeneous primary radiations which included a large range of wavelengths. The scatterers used were filter paper, paraffin wax, aluminum, carbon, and sulfur. Tabulated data are given for the ratio of the intensity of the scattered radiation at angles of 20°, 30°, and 150° (with the direction of the primary beam) to the intensity of the scattered radiation at 90°. For backward scattering, the data agree closely with theoretical values expected from the quantum theory of Dirac, whereas for foreward scattering the picture is complicated by interference effects.

387 A Theorem in the Charge-Symmetrical Meson Theory by W Heitler Proc Roy Irish Acad 51 Sec A 33-39 (1946)

The author shows that the invariance of the nuclear potentials of the proton against rotations in charge space, as defined by Kemmer (Proc Cambridge Phil Soc 34 354 (1938)), results in a particular relationship between the various scattering cross sections which is more complicated than might be expected. It is necessary to distinguish between two different charge spaces, a three-dimensional one and a two-dimensional one. The meson field has three real components, whereas the wave function of a nucleon, as far as it depends on its charge (0 or 1), is a two-component vector. The basic vectors and their components are defined and it is noted that the probability amplitudes for the scattering process are invariant against charge-transformations. Relations are thus obtained expressing the trivial facts that the scattering of a neutretto by a proton is the same as that by a neutron and that the scattering of a positive meson by a proton is the same as that for the scattering of a negative meson by a neutron; in addition, non-trivial relations for the scattering of a positive meson by a neutron, a positive meson by a proton, and a neutretto by a proton, and for the transformation of a positive meson into a neutretto are obtained. From these non-trivial cases a relationship between the cross sections for scattering of both protons and neutrons by variously charged mesons is derived which holds rigorously for the differential cross sections as a function of the angles and for all specified spin-directions in any approximation used for the calculations.

ABSORPTION AND SCATTERING OF RADIATION (continued)

388 Variational Methods in Nuclear Collision Problems by W Kohn Phys Rev 74 1763-1772 (1948) Dec 15

Variational methods, similar to the Rayleigh-Ritz method for bound state calculations, are developed for the phase shifts and elements of the scattering matrix in nuclear collisions. Numerical applications to neutron-proton and neutron-deuteron scattering involving trial functions with undetermined coefficients are described. Another variational principle, for scattering amplitudes, is shown to lead to the Born approximations and a formula recently derived by Schwinger. The principle may also be used in conjunction with the method of undetermined coefficients.

ASTROPHYSICS

389 The Coronal Emission Spectrum by R v d R Woolley and C W Allen Monthly Notices Roy Astron Soc 108 292-305 (1948)

The ionization in the corona is computed by supposing it to be determined by a balance between ionization by electron impacts and photoelectric recombinations. An estimate of the abundance of elements in the corona, from coronal line intensities in relation to the electron scatter continuum, gives a hydrogen to metal ratio of 6000:1 by numbers. The abundances of H, Fe, Ni, Ca, and A obtained from corona data are compared in tabular form with the cosmic abundances of elements 1 to 30 obtained by numerous investigators.

390 On the Nature of the Solar Particles (O Prirode Solnechnych Korpuskul) by N M Gnevyshev Astron Zhur 25 109-122 (1948) Mar-Apr (In Russian)

The known facts on polar auroras and geomagnetic storms are best explained by the hypothesis of particle streams originating in the regions of activity on the sun's surface. From the latitude distribution of the intensities of the magnetic disturbances, the author concludes that a vertical stream exists, the horizontal section of which can be evaluated in each particular case. For strong magnetic storms, the electric current thus determined reaches 0.6×10^5 amp. Studies of the fluctuations in the geomagnetic field show that the particle streams should be visualized as clouds which, due to velocity dispersion, assume an elongated shape while traveling from the sun to the earth. Analysis of the velocity distribution gives as the most probable value 2.5×10^9 km/sec. The ratio e/m is found to be 3.3×10^3. The most probable composition of solar streams would thus be a mixture of α-particles and doubly ionized helium atoms. The velocity given above closely approaches that of α-particles emitted during thorium disintegration (2.2×10^9 km/sec). In this connection the author cites (1) the finding of thorium lines in the spectrum of the active regions on the sun's surface by C E Moore and A S King (Pubs Astron Soc Pac 55 36 (1943)) and (2) the hypothetical picture of nuclear reactions in the same regions suggested by M N Saha (Proc Nat Inst Sci India 8 (1942); Proc Phys Soc (London) 57 271 (1945)).

ATOMIC BOMBS

391 The Atomic Bomb by F L Mohler. AECD-2423 nd Decl Dec 21 1948 33p

A history of the developments leading to the production of the atomic bomb and the techniques involved is presented in narrative style. Two years of basic research is reported. Administrative organizations and personnel, technical problems and analytical methods are reviewed.

ATOMIC POWER

392 Nuclear Power Chem Trade J 121 248 and 250 (1947) Sept 5

This is a very brief and very general discussion of Professor J. D. Cockcroft's talk on the various nuclear reactors built for scientific research. The graphite pile, the heavy water pile, and the reactors using pure plutonium or U^{235} are mentioned, as are the problems of radioactive gases and waste disposal.

ATOMIC POWER (continued)

393 Nuclear Reactor at Brookhaven National Laboratory by L B Borst, M Fox, D H Gurinsky, I Kaplan, R W Powell, C Williams and W E Winsche Phys Rev 74 1883-1884 (1948) Dec 15 (Letter to the editor)

The nuclear reactor at Brookhaven is described as an air-cooled unit constructed of graphite and unenriched uranium metal. The maximum thermal neutron flux is expected to be about 5×10^{12} neutrons per square centimeter per second. The construction of the shield is described in some detail and the construction and facilities of the "hot" laboratory for work on sources of intense radiation are briefly discussed. Three distinct types of facilities will be available within this laboratory, i.e., (1) "hot-cells" for processing samples up to 50 curies of 2-Mev γ-activity by remotely controlled apparatus; (2) "semi-hot cells" for work with samples of 1 millicurie to 1 curie of 2-Mev γ-rays using semi-remote control techniques including tongs and special manipulators; and (3) "semi-works" area in which large apparatus can be erected with appropriate portable shielding.

394 Rocket Propulsion by A V Cleaver Forecast 10 511-519 and 524 (1948) Dec

The history and future of rocket development are discussed. In treating the potential applicability of rockets to travel in space beyond the earth's gravitational field, the possibility of providing sufficient power by utilizing nuclear energy is mentioned. It is suggested that a light gas, such as hydrogen, could be used in the exhaust jet of the rocket to increase the exhaust velocity enormously, if an atomic energy source could be substituted for the chemical combustion source now used to heat the working fluid in the rocket chamber. A schematic diagram illustrating the possible construction of such an atomic rocket motor is shown.

BIOLOGICAL EFFECTS OF RADIATION

395 Blood Changes in Humans Following Total Body Irradiation by J J Nickson. AECD-2432 (CH-3868) June 2 1947 Decl Dec 21 1948 64p For publication in NNES

Results of examinations of elements of the peripheral blood in fourteen individuals following exposure to total body radiation are presented. The individuals are divided into three groups: Group I consists of eight individuals who were irradiated with x-rays at one sitting; Group II consists of three individuals who were irradiated with x-rays in divided doses; and Group III consists of three normal individuals who were irradiated with x-rays by 3 doses of 7 r each. In Group I the most persistent abnormality noted was a diminution in the number of lymphocytes shortly after the completion of the treatment. In Group II depression in the lymphocytic count was also the most marked single change. In Group III no alterations were noted in the elements of the peripheral blood which were studied.

396 Asymmetrical Suppression of Vertebral Epiphyseal Growth with Ionizing Radiation by Alvin Arkin, Norman Simon and Robert Siffert Proc Soc Exptl Biol and Med 69 171-173 (1948) Oct

The lumbar spines of 30 young rabbits were unilaterally irradiated with radon seeds and x-rays. Twenty-one animals died of gastro-intestinal disturbances unrelated to radiation. Five of the 9 survivors showed wedging of the vertebral bodies with the narrowing of the bodies on the more heavily irradiated side. Dosage estimates indicate the growth of the epiphyses of the vertebral bodies of baby rabbits may be suppressed with 700 to 1000 r to the epiphysis. Doses of 350 r or less have no apparent effect on the growth.

397 The Biological Effects of Radiation; Progress Report for the Period January 1947 to June 1947 by J H Lawrence and H B Jones. University of California (Office of Naval Research Contract) June 30 1947 6p (NP-516)

Two growth inhibiting factors, dibenzanthracene and a folic acid derivative, were found not to inhibit desoxyribose nucleic acid metabolism as does ionizing radiation. It was possible to irradiate bone marrow effectively using a radioactive colloid which is highly concentrated in bone marrow. The

BIOLOGICAL EFFECTS OF RADIATION (continued)

depression of bone marrow nucleic acid metabolism did not seem to be as sensitive to irradiation, relative to its general radiosensitivity, as compared to liver. The enzymatic systems responsible for the synthesis of thyroxine were extremely resistant to irradiation in contrast to nucleic acid metabolism. Techniques have been worked out to test the effects of irradiation on various organic metabolic processes using radioactive carbon.

398 Cytology of Rabbit Thymus and Regeneration of its Thymocytes after Irradiation; with Some Notes on the Human Thymus by Hal Downey Blood 3 1315-1341 (1948) Dec

Newly born rabbits and young normal rabbits 4 to 5 months of age were irradiated for this study of regeneration of lymphocytes in the thymus. A detailed study of the lymphocytes and of cells from the epithelial and mesenchymatous reticulum, and of the granulocytes was made on non-irradiated animals. The following conclusions were reached. Thymocytes are genuine lymphocytes. The largest lymphocytes of lymph nodes do not occur in the thymus; the smallest ones with pacychromatic nuclei and scanty cytoplasm are more numerous in the thymus. Some lymphoblasts similar to myeloblasts occur in the rabbit thymus.

All three types of granulocytes develop from lymphocytes and to some extent from the mesenchymatous reticulum in the rabbit. In the rabbit the heterophil and eosinophil granules are acidophilic when first formed, while in the human thymus many have a basophilic quota as in the marrow. The reticulum is largely of epithelial origin and retains its epithelial characteristics in cytoplasm and nucleus. In the rabbit some mesenchymatous tissue is blended with the reticulum and may give origin to lymphocytes and granulocytes. The epithelium may form macrophages but does not differentiate to lymphocytes and other types of cells. In imprints from the rabbit the epithelial cells usually can be distinguished from those of the mesenchymatous reticulum. During regeneration following irradiation the latter tissue can be seen to form some lymphocytes locally; other lymphocytes enter the organ through the lymph vessels.

Imprints stained with May-Grünwald and Giemsa are of great value for detailed cytology of the thymus and for determining cell relationships. Sections of thymus fixed in Helly's fluid, stained with methyl green and pyronin and dehydrated in dioxan are excellent for lymphocytes and the transitional stages resulting from their development from fixed mesenchymatous tissue during regeneration of the organ following exposure to X-rays. 56 references, 17 figures.

399 Disfiguring Sequelae from Radium Therapy by G B Underwood and L E Gaul Arch Dermatol and Syphilol 57 918-919 (1948) May

An angioma cavernosum, 6 cm. in its greatest diameter, near the left breast of a 3-months-old girl was treated with radium and had disappeared after 5 months. However, at 12 years of age the left breast was dwarfed to about one-quarter the normal size of the right one. It represents a lack of glandular development caused by irradiation and the authors comment that a warning should be given in all texts concerning possible sequelae after the irradiation of nevi located over, or adjacent to, developing glandular tissues.

400 The Effect of Discontinuous X-irradiation on Reticulocytosis in the Mouse (Die wirkung der diskontinuierlichen Röntgenbestrahlung auf die Retikulocytenwerte der Maus) by I G Heeren Strahlentherapie 77 383-386 (1948) (In German)

The course of the reticulocyte count in male white mice was used to compare the effects of continuous and discontinuous irradiation. In both cases the dose was 100 r in 9 minutes. The lowering of the reticulocyte value was less after discontinuous irradiation. The reticulocyte count fell from an average of 5.5 to 2.5% 2 to 3 days after continuous irradiation. It had risen to 10.6 to 18.5% 6 days after and subsequently moved rhythmically between these values. However, after discontinuous irradiation, produced by a rotating lead shutter with an irradiation-interval relation of 1 to 9, the fall was less 3 days after, namely 3.6 to 4%, and subsequent variations lay between 12.3 and 15.4%. With 16

BIOLOGICAL EFFECTS OF RADIATION (continued)

intervals per second the figures were 3.6 and 16.5 to 31.2%. The author concludes that it is possible through rhythmical interruption of irradiation to regulate the irradiation reactions of tissue. 10 references.

401 The Effects of Single Dose Total Body X-Irradiation on the Peripheral Blood of the Rat by S P Stearner, E L Simmons and L O Jacobson Anat Record 99 576-577 (1947) Dec

This article is based on MDDC-1319. An abstract of this document has been listed in Abstracts of Declassified Documents 1 723 (1947) Dec 20

402 Effects Resulting from Atomic Bomb Explosion by F L Price J Florida Med Assoc 34 651-653 (1948) May

The atomic bomb explosions in Hiroshima and Nagasaki created a blast wave that lasted almost a second in contrast to the few milliseconds of pressure resulting from an ordinary explosion. No estimate of the number of deaths or symptoms caused by blast pressure could be made, but the pressure developed on the ground under the explosion was not sufficient to kill more than those people who were very near the center of damage. In Hiroshima 60% and in Nagasaki 95% of immediate deaths were caused by burns, and 90% of the burns suffered by patients who reached first aid stations were second degree. The radiations which caused injuries were primarily those created within the first second after the explosion; and it is estimated that gamma rays and neutrons caused about 7% of the deaths. The irradiation effects of nausea and vomiting, fever, diarrhea, purpura, ulcerations of the mucous membrane, and leukopenia varied in intensity according to the severity of irradiation. Death followed within 10 days of severe injury, and mortality was 50% for those receiving moderate injury. There was almost complete disappearance of all cells of the myelopoietic and erythropoietic series. Men who had received enough radiation to produce symptoms did not have spermatozoa and most of the spermatogenic tissue was replaced by proliferating cells of Sertoli. The female reproductive system was affected to a much smaller extent. In Nagasaki the estimated radiation intensity at a distance of 1250 meters from the point of explosion was 473 r. It is believed that the mortality rate for all types of injuries could have been reduced if electrolite solutions, plasma, whole blood, and penicillin had been available.

403 Immediate and Delayed Biochemical and Biological Effects of Irradiation on Animal Tissues. Status Report No. 3 for the Period June 1947 to December 1947. University of California Division of Medical Physics (Office of Naval Research Contract) nd 14p (NP-512)

Methods of selective tissue irradiation have been perfected for liver, spleen, and bone marrow. The status of the various investigations dealing with these specific irradiated tissues is summarized. A preliminary report of the effect of irradiation upon thyroid metabolism is attached. It is noted that even extreme irradiation dosages have little effect upon iodine metabolism in the thyroid gland.

404 Increase in I^{131} Uptake of Thyroid after Whole Body Roentgen Irradiation by T C Evans, Grace Clarke and Estelle Sobel Anat Record 99 577 (1947) Dec

Adult male rats were exposed to x-rays (500 r and 1000 r) and 2 days later a tracer dose of radioactive iodine was given subcutaneously. Twenty-four hours after I^{131} administration, thyroids were removed and relative amount of radioactivity determined. The activity in the thyroids of the irradiated animals was much higher than that of the controls. Animals were tested at different times after irradiation and the maximum increase in activity (relative to that of the controls) occurred during the third day after the irradiation. At this time the leukocyte count was very low. Increased activity of the thyroid in the irradiated animals occurred even when the thyroid itself was not irradiated. In fact, the largest relative activity of the thyroid occurred in an animal receiving irradiation over the abdomen (head and thorax protected with lead). The I^{131} content of the blood of the irradiated animals

BIOLOGICAL EFFECTS OF RADIATION (continued)

was usually higher than that of the controls. In one experiment, the thyroid of adrenalectomized rats did not retain as much radio-iodine as did those with the gland. Irradiated animals without adrenals showed an increase in I^{131} over their controls (without adrenals) in about the same proportion as if adrenals were present. Newborn rats (3 days of age) did not respond in the same way as did the adults. Irradiation of the babes resulted in a partial depression of the I^{131} uptake of the thyroid.

405 Physiological Effects of the Atom Bomb (Les Effets Physiologiques de la Bombe Atomique) Atomes 3 244 (1948) July (In French)

This is a brief summary of the studies made on the survivors at Nagasaki and Hiroshima, and on the animals used in the tests at Bikini.

BIOLOGY, GENERAL

406 Studies of the Unsaturation of Phospholipid Fatty Acids of the Liver, Kidney and Blood of Uranium-Poisoned Rats by R S Crossland, F L Haven and V M Edwards. AECD-2428 (M-1877) Jan 1946 Decl Dec 29 1948 46p Proposed for publication in Proc Soc Exptl Biol and Med

The effect of uranium nitrate on the unsaturation of the phospholipid fatty acids of the liver, kidney and blood of rats has been studied. It was found that with an acute dose (5 mg/kg injected intraperitoneally) the iodine number of the liver was increased about 14 per cent. The iodine number of the kidney was decreased about 25 per cent. A limited number of determinations on the blood fatty acids showed an increase of 20 per cent. When repeated small doses (0.33 mg/kg) of uranium nitrate were given followed by an acute dose, the iodine numbers of both the liver and kidney of these tolerant animals were normal. Apparently the repeated small doses prevent the changes in unsaturation, which are caused by a single acute dose. Two series of rats, which had survived an acute dose of uranium nitrate showed normal average and low average iodine numbers, respectively, for liver. Those values showed the greatest variation of any series for liver, with a large percentage of the figures falling below normal. The iodine numbers for the kidney were, likewise, normal and low normal, respectively, for the two series. When rats were given a sub-acute dose of uranium nitrate (2.5 mg/kg) the iodine number for the liver was elevated about 11 per cent. The value for kidney, however, was a low normal. If any injury to the kidney had occurred, as was indicated by the ratio of kidney to body weight, such injury had been repaired, while the corresponding injury to the liver apparently persisted.

407 Effect of Zirconium and Sodium Citrate on the Distribution and Excretion of Yttrium and Plutonium by Jack Schubert. AECU-38 (ANL-4206) Aug 1 1948 11p (See also AECD-2358)

In a previous report it has been shown that zirconium, when administered as the citrate salt, increases the excretion of plutonium and yttrium and reduces its concentration in the bone. (Schubert, Science 105 p. 389, 1947). These studies have been extended and preliminary data are briefly described in this report.

408 Excretion of Radium from the Mouse by Joanne Weikel and Egon Lorenz Radiology 51 865-870 (1948) Dec

This article is based on MDDC-1587. An abstract of this document has been listed in Abstracts of Declassified Documents 2 13 (1948) Jan 15.

409 The Relation of Particle Size of Uranium Dioxide Dust to Toxicity Following Inhalation by Animals by H B Wilson, G E Sylvester, Sidney Laskin, C W LaBelle and H E Stokinger J Ind Hyg and Toxicol 30 319-331 (1948) Nov

This article is based on AECD-1963. An abstract of this document has been listed in Abstracts of Declassified Documents 2 307 (1948) June 15.

BIOLOGY, GENERAL (continued)

410 Renal Function in Normal Rabbits and Dogs and the Effect of Uranyl Salts by J Henry Wills and Edna Main Amer J of Physiol 154 220-228 (1948) Aug 1

This paper presents a study of the effects of uranium on the handling of chloride, inulin, and diodrast by the dog and rabbit kidney, the organ predominantly affected by the administration of uranium. In the kidney of the normal dog and rabbit the clearance of chloride and the reabsorption of chloride by the tubule are functions of the urine rate; the value of the chloride clearance increases with urine rate and the fractional reabsorption of chloride decreases slightly. However, the ability of the kidney to clear diodrast from the blood by secretion is not a function of urine rate. Under the conditions of the experiments the inulin clearance appears to be a function of urine rate in the dog but not in the rabbit. The effect of uranyl salts on the function of the proximal convolution leads to decreased reabsorption of chloride, decreased secretion of diodrast, and probably to increased permeability of the tubular membrane to water and dissolved substances. 18 references. 4 tables.

411 Therapy of Acute Fluoride Poisoning by J H Peters Amer J Med Sci 216 278-285 (1948) Sept

One case of serious acute fluoride poisoning where the patient had taken at least 10 times the reported lethal dose and recovered is reported as an illustration of the disturbances of metabolism which may accompany such poisoning. A general outline of therapy is offered. It includes quick action, intravenous therapy with glucose in normal saline, saline stomach lavage, intravenous administration of calcium, maintenance of high urine volume, and precautions against external burns from vomitus, feces, and urine. Hydrofluoric acid burns have been effectively treated by infiltration with calcium gluconate followed by soaking in Epsom salts. 55 references.

BOTANY

412 An Isotope Effect in Photosynthesis by John W Weigle and M Calvin. AECU-55 (UCRL-228) Nov 23 1948 5p

In the course of some kinetic studies on photosynthesis of barley seedlings, it has been found that plants utilize $C^{12}O_2$ faster than $C^{14}O_2$. The plants were placed in a closed system containing an infrared absorption-cell for the analysis of total CO_2 and an ionization chamber for the determination of $C^{14}O_2$ in the gas phase, both instruments recording continuously. Carbon dioxide, containing about 2% $C^{14}O_2$, was introduced in the dark and the specific activity at this point taken as unity. After a short dark period, the lights were turned on. As photosynthesis proceeded, the specific activity of the residual CO_2 rose to a peak 20% higher than it had been at the start of photosynthesis.

CERAMICS AND REFRACTORIES

413 Applications of Super-Refractories Made from Electric Furnace Products by Charles F Geiger, Arthur A Turner and Otto R Stach Chem Eng Progress 44 933-936 (1948) Dec

This is a general discussion of bonded refractories made from silicon carbide, fused alumina, and synthetic electric mullite, as well as electrically fused-cast refractories, as these materials apply to the chemical industry. Physical properties of the bonded refractories made from electric furnace products are given, and the need for determining the exact use to be made of the refractory is pointed out.

414 Fibrous Silica — A New Engineering Material by Leon Parker and John J Foster Chem Eng Progress 44 937-942 (1948) Dec

Fibrous silica, a material which may be used continuously at 2000°F, is described, and the properties and uses are given.

415 High-Temperature Ceramic Coatings for Steel Ind Heating 15 1804-1812 and 1817 (1948) Oct

War-time research has yielded several ceramic coatings for high temperature protection of

CERAMICS AND REFRACTORIES (continued)

mild steels, it was revealed by W. N. Harrison, National Bureau of Standards, at the recent Symposium on Modern Metal Protection at Cleveland, Ohio. High chipping resistance, protection against oxidation, and freedom from cracking and blistering were features especially emphasized. A ceramic coating, NBS A-19, consisting of 50 parts of "soft", or fusible frit, 50 parts of "hard", or infusible frit, 25 parts of calcined alumina, 10 parts of enamelers clay, and other minor ingredients, was particularly resistant. The speaker also discussed the peace-time application of such coating.

416 New Alumina-Silica Refractories by G Bickley Remmey Chem Eng Progress 44 943-946 (1948) Dec

Crystals of mullite and alumina being the only stable components of silica and alumina at temperatures above 3200°F, research work was done to develop mullite bricks having properties closely approaching pure corundum. Five distinctly new types of refractories are listed: the mullite bonded mullite, pure alumina refractories, a light weight mullite, a vitrified mullite, and a vitrified or low porosity alumina. Results of tests showing the differences between the various refractories are given, and the properties of the "crystalite," a brand name given to the mullite refractories bonded with mullite crystals, are listed.

417 Pure Oxide Refractories Withstand High Temperatures by O J Whittemore Jr Materials & Methods 28 No. 6 79-81 (1948) Dec

Pure oxide refractories have been developed to withstand exceedingly high temperatures — above 1650°C (3000°F). The distinguishing characteristic of the group is that each is composed of a single refractory oxide. Because they are composed of a single oxide, they are (1) free from the fluxing effect of the lower melting ingredients in a mixture, and (2) monocrystalline and self bonded as opposed to the glass-bonded refractories of the fireclay type. The oxides, in order of increasing cost, are alumina, magnesia, zirconia, beryllia, and thoria. Some of the special properties of these oxides are as follows: Alumina: (a) fusion point — 2000 to 2045°C (3632 to 3713°F); (b) very stable in both oxidizing and neutral atmospheres; (c) practical upper working limit, about 1900°C (3452°F). Magnesia: (a) fusion point — 2800°C (5072°F); (b) reduces readily at high temperatures; (c) fair to poor resistance to thermal shock. Zirconia: (a) fusion point when pure — 2715°C (4919°F); (b) stable in oxidizing atmospheres; fairly stable in reducing atmospheres; (c) thermal conductivity rather low; (d) difficult to use in pure state because of change in crystalline structure at about 1100°C (2012°F), with change of volume; (e) stabilized zirconia, containing small percentages of lime or magnesia, stabilized in cubic form, but softens at slightly lower temperatures. Beryllia: (a) fusion point — 2520°C (4568°F); (b) resistant to reduction; (c) excellent thermal conductivity, comparable to that of metals; (d) moderately high thermal expansivity, but good thermal shock resistance because of high thermal conductivity; (e) volatilizes above 1650°C (3002°F) in presence of water vapor; (f) toxic to respiratory system. Thoria: (a) fusion point — 3050°C (5522°F), the highest of the oxides; (b) heavy; density 9.6 gm per cc; (c) thermal shock resistance poor; (d) radioactive, therefore toxic.

418 Upper Useful Limits of Commercial Superrefractories by G Bickley Remmey Amer Ceram Soc Bull 27 477-485 (1948) Dec 15

Eighteen different brands of fabricated mullite and alumina refractories, as well as one zircon and one zirconia brick, were tested to determine their upper limits of use. Reheat tests were run for four hours with the temperature held constant at six values ranging from 3000° to 3500°F, from which the shrinkage effects on each sample were calculated. Pyrometric cone equivalent and load tests were also made. In addition to the test results, the methods used are outlined as a suggested procedure for evaluating such superrefractories. Data are also given on the temperatures at which zircon and zirconia react with mullite and alumina. The extremely fluid nature of the glasses formed at 3350°F and above is illustrated.

The new mullite and alumina refractories have been shown to have properties closely approaching the theoretical limits of pure mullite and corundum. These improvements extend the upper limit of

CERAMICS AND REFRACTORIES (continued)

use for mullite by 225 to 325°F and for alumina refractories by 200 to 500°F.

The improvement in the new mullite refractories is explained by the high concentration of interlocking mullite crystals which do not soften much below their dissociating point — 3326°F. In the case of the alumina refractories, the improvement is explained by the elimination of components that form fluid glasses at high temperatures. Some of the new-type mullite refractories are shown to be serviceable at higher temperatures than the older clay-bonded types of alumina, in spite of their lower market price. Tables and graphs are included.

CHEMISTRY, ANALYTICAL

419 Use of Ion Exchangers in Analytical Chemistry by R H Lafferty Jr. AECD-2414 (K-302) Nov 19 1948 Decl Dec 15 1948 16p Proposed for publication in Analyt Chem

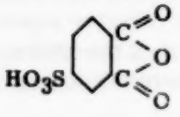
A review has been made of the uses of organic ion exchangers in analytical chemistry. These materials are used in analysis to remove impurities or interfering ions, to concentrate ions and to separate substances prior to determination. 56 references.

420 The Ion-Exchange Separation of Zirconium and Hafnium by Kenneth Street Jr and G T Seaborg. AECD-2435 (UCRL-191) Oct 11 1943 Decl Nov 10 1948 4p Proposed for publication in J Amer Chem Soc

A method of separating zirconium from hafnium was developed. Although the conditions which give satisfactory separation were first worked out using microgram amounts of material and the radioactive tracer technique, the run which is described involving milligrams of material, illustrates the applicability of the method to the production of significant amounts of pure hafnium and zirconium. It can be seen that ~ 66 percent of the starting hafnium oxide, i e 10 mg, is obtained containing ~ 0.1 percent zirconium oxide by weight. The column used in these experiments was relatively small.

421 Cation-Exchange Resins Prepared by Condensing Sulfophthalic Anhydride and Xylene by Stanley P Rowland, Philadelphia, Pa., assignor to Rohm and Haas Company, Philadelphia, Pa. U S Patent No. 2,456,085 Dec 14 1948

Cation-exchange resinous compositions have been prepared comprising the insoluble and infusible reaction products of xylene and sulfophthalic anhydride. These resinous compositions are insoluble in aqueous solutions of acids, bases, and salts and are particularly suitable for adsorbing cations from fluids. The sulfophthalic anhydride and xylene are mixed and heated in the ratio of at least two mols of xylene for mol of anhydride, splitting off water and resulting in a jelly-like mass which yields a hard, insoluble, infusible, porous resinous product after being dried and heated. The formula is



422 Chromatography (La Chromatographie) by F Appell La Nature 3162 292-295 (1948) Oct (In French)

A general fundamental discussion of chromatography and its applications.

423 Determination of Zirconium Present in the Elementary and Oxidized States in Commercial Zirconium by Isaburo Wada and Raizo Ishii Bull Inst Phys Chem Research (Tokyo) 21 877-883 (1942)

Taking advantage of the fact that Zr dissolves in cold dilute HF, while the oxidized state does not, the authors determined Zr in commercial samples. This method is shown to be preferable to the method using weight increment determination by oxidation.

424 Ion Exchangers to Separate, Concentrate and Purify Small Amounts of Ions by Waldo E Cohn, George W Parker and Edward R Tompkins Nucleonics 3 No. 5 22-23 (1948) Nov

This article is based on MDDC-1447. An abstract of this document has been listed in Abstracts of Declassified Documents 1 782 (1947) Dec 30.

CHEMISTRY, ANALYTICAL (continued)

425 A New Method of Measuring the Concentration of Radioactive Bromine in Biological Materials (Nouvelle Méthode de Mesure de la Concentration du Radio-brome dans le Matériel Biologique) by P Daudel, S Neukomm, E Lesein, L Henriet and R Daudel Experientia 4 356-357 (1948) Sept 15 (In French)

A method is described which is based on the precipitation of radioactive bromine in the form of its silver salt after extraction of the biological material with a suitable solvent. When the method was employed in a study of triphenylethylene bromine, a synthetic estrogen, its average error of recovery was found to be 4.5%. The principles of the method described seem to be applicable to biological radioactive tracer studies in general.

426 On the Chemical Behavior of Radioactive Materials in Microquantities during Precipitation Reactions (Über das chemische Verhalten von radioaktiven Stoffen in unwägbaren Mengen bei Fällungsreaktionen) by E Jacobi Helv Chim Acta 31 No. 7 2124-2127 (1948) (In German)

The author has studied the separation of newly formed elements from nuclear reactions. The best way of creating conditions for separation is by dissolving in concentrated acids and obtaining ionic solutions. The work done by Fajans (Berichte der deutschen chemischen Gesellschaft 46 3486 (1913)), Paneth (Jahrbuch der Radioaktivität und Electronik 11 451 (1914)), and Hahn (Naturwissenschaften 14 1196 (1926); Zeitschrift für Physikalische Chemie 144 161 (1929)) points the way to separation by precipitations. The author has divided the precipitation reactions into several classes in order to facilitate future work.

I. Crystallization (small-surface precipitation)
   a. Mixed crystals formation b. No mixed crystals formation
II. Large-Surface precipitation
   a. Mixed crystals formation b. No mixed crystals formation
III. Separation on preformed precipitates
   a. Mixed crystals formation b. No mixed crystals formation

A diagrammatic scheme is presented, giving these divisions, which would facilitate the choice of a suitable carrier or effective precipitation conditions for a given radio element.

427 Partition Chromatography of Amino Acids on Starch by S Moore and W H Stein Ann New York Acad Sci 49 265-278 (1948) Feb 10 Reprinted in Studies Rockefeller Inst Med Res 136 1-14 (1948)

Experiments were performed in the field of partition chromatography with the aim of isolating and identifying amino acids and peptides in biological materials, using a starch column. In adopting this previously worked out technique, two additions were made to the procedure. The effluent was divided into a series of small fractions of known volume instead of collecting the effluent from the chromatogram in large portions. For this purpose an automatic fraction collector was installed which used a photocell to register the drops emerging from the column. Then the drops were counted by an automatic reset impulse counter. The fractions collected were analyzed quantitatively rather than qualitatively by a modified ninhydrin method. The data obtained in this manner permitted the construction of effluent concentration curves revealing the detailed behavior and full resolving power of the column.

Graphs were presented showing the separation of the various amino acids and of the peptides. Their behavior on the column has been studied in relatively few experiments. The values obtained by the method described were in good agreement with results reported previously. The conclusion may be reached that by chromatography on starch columns it is possible to obtain sound quantitative as well as qualitative pictures of mixtures of free amino acids and related compounds. Additional work is planned in order to investigate further the advantages and disadvantages of the method and its application to the problems of biochemistry. 14 graphs, 2 tables, and 1 photograph.

CHEMISTRY, ANALYTICAL (continued)

428 Radioactive Determination of Potassium in Solids by Antoine M Gaudin and James H Pannell Analyt Chem 20 1154-1156 (1948) Dec

The method of Barnes and Salley (Ind and Eng Chem, Analytical Edition 15 4-7 (1943)) for analyzing aqueous potassium solutions has been extended to solid samples and made more sensitive and useful. A thin-walled cylindrical Geiger-Mueller counter is used, and the sample depth has been made large enough to be to all intents infinite for the least dense material one expects to analyze. By counting for a sufficiently long period of time, samples assaying even less than 0.1% potassium can be analyzed. Tables are given showing the times necessary to count samples to 2% probable error, with a definite background and showing the accord in assays obtained by chemical analysis and by the apparatus described. The straight line relationship between counts per minute and per cent potassium is indicated.

429 The Use of Fluorescent Silica Gel Mixtures in the Chromatography of Colorless Compounds by John W Sease J Amer Chem Soc 70 3630-3632 (1948) Nov

The use of an adsorbent containing 2.5% zinc silicate and 2.5% zinc sulfide gave a continuous excitation range from 390 to 230 mμ. This adsorbent was used to chromatograph 40 binary mixtures involving 25 different compounds, employing a hydrogen lamp. Detailed descriptions and adsorption sequences were given.

CHEMISTRY, GENERAL

430 Chemistry of Thorium in Aqueous Solutions. I. The Thorium-Iodate System: Solubility and Complexes by A J Fry, J E Barney II and R W Stoughton. AECD-2429 (ORNL-63) nd Decl Dec 30 1948 37p

The apparent solubility of thorium iodate was measured at an ionic strength of 0.5, a pH of 2.6 and 25°C as a function of total Th(IV) and total iodate in solution. Using semi-graphical methods the various solubility constants involving the different ionic species were determined, and from these the stability constants of eight ionic species were calculated. Experimental values for the extraction of trace quantities of thorium into an organic medium as a function of iodate concentration in the aqueous phase agreed entirely satisfactorily with calculation.

431 The Boron Hydrides and Related Compounds by R P Bell and H J Emeléus Quart Revs 2 132-151 (1948)

The methods of preparation, reactions, and structural problems of the borohydrides, their derivatives, and some analyses are discussed by the authors, special emphasis being placed on the work done since 1930. The vibrational spectrum and thermodynamic properties are included in the paper. 69 references.

432 Chemical Kinetics of Bromine Following Neutron Capture by William H Hamill and Russell R Williams Jr J of Chem Physics 16 1171-1172 (1948) Dec (Letter to the Editor)

The authors investigated the work done by Suess (Z Physik Chem B45 297 (1939)) on a study of the $Br^{79}(n,\gamma)Br^{80}$ kinetics by following the distribution of Br^{80} (18 min) between addition to ethylene and exchange with HBr in the gas phase and using stronger neutron sources for greater precision. An equation for the kinetics is given, and the left hand side of same plotted as a function of ethylene pressure.

433 Chemistry of Thorium. Quantitative Estimation of Thorium by Precipitation with Radioactive Pyrophosphate by Therald Moeller and George K Schweitzer Analyt Chem 20 1201-1204 (1948) Dec

A method of estimating thorium in the presence of yttrium and the rare earth elements has been developed by making use of the work done by Langer (J Phys Chem 45 639 (1941)), who followed

CHEMISTRY, GENERAL (continued)

titrations of metal salt solutions with standard disodium orthophosphate solution containing radioactive phosphorus, and the work of Carney and Campbell (J Amer Chem Soc 36 1134 (1914)), who found thorium to be quantitatively precipitated and removed from the elements by precipitation with pyrophosphate from solutions of 0.3 N in hydrochloric acid. The procedure as adopted is, however, not a titration but rather an addition of excess pyrophosphate of known activity and a measurement of the excess through its exhibited activity. The solubilities of pyrophosphates of lanthanum, cerium (III), cerium (IV), yttrium, and thorium in hydrochloric acid solutions have been measured and the data are given.

434 The Designation of Special Isotopes in the Names and Formulas of Inorganic Compounds by George W Watt Science 108 740-742 (1948) Dec 31

The author lists a number of recommendations for designation of isotopes in inorganic compounds, indicates their limitations, and gives reasons for adoption. The proposals assume the isotope to be present in substantially pure form. The following rules are set forth. (1) In both formulas and names, isotopes are designated by mass numbers supplemented where necessary by the appropriate symbols. It is not considered necessary to indicate whether the isotope is stable or radioactive. (2) The mass number is written as a right superscript. (3) In the names, a special isotope is designated by insertion of the mass number immediately following the appropriate part of the systematic name. The mass number is set apart by a hyphen or hyphens and preceded by the corresponding symbol whenever the compound involves two constituents having overlapping ranges of mass numbers. (Example: $Co_2(C^{14}O)_8$ = dicobalt octacarbonyl-C14) (4) Partial substitution by a special isotope is indicated by application of the foregoing rules, inclusion of the appropriate symbol, and insertion of a suitable coefficient specifying the extent of substitution. (5) When necessary to specify both mass number and ionic charge, the symbol together with the mass number as a right superscript is enclosed in parentheses and followed by the usual charge designation. (6) Metastable nuclear species are denoted by appending the lower-case letter m to the mass number. (Example: $HgBr_2^{80m}$ = mercury (II) bromide-80m) The author invites comments and suggestions.

435 Manufacture of Hydrogen Fluoride by Abner C Hopkins Jr, Hempstead and Richard M Stephenson, Long Island City, N. Y., and William E Watson, West Orange, N. J., assignors to Allied Chemical & Dye Corporation, N. Y. U S Patent No. 2,456,509, Dec 14 1948

An improved method for the separation and recovery of hydrogen fluoride from crude HF gases, particularly those contaminated with silicon fluoride, has been devised. Any impure gas containing HF can be handled by this method and substantially anhydrous hydrogen fluoride produced. Since the temperatures in the system are nowhere higher than 164°C, corrosion problems are largely eliminated and mild steel may be used as construction material. Essentially the method consists of contacting the dry gas mixture with substantially anhydrous fluosulfonic acid, keeping the absorbent below 40°C. Gaseous SiF_4 is discharged from the absorbent, and the liquor is then heated to 160-164°C to strip the HF out.

436 On the Thermal Dissociation of Tetrafluoroborates (O Termicheskom Razlozhenii Tetraftoroboratov) by I G Ryss and E M Polakova Zhur Obshcheĭ Khimii 18 286-288 (1948) Feb (In Russian)

Previous studies on the thermal dissociation of the tetrafluoroborates have been concerned almost exclusively with the alkaline salts. It was to be expected that the alkaline earth salts would show lower dissociation temperatures (decreasing from Ba to Ca). The authors have confirmed this for the case of $Ba(BF_4)_2 \cdot 2H_2O$. This salt loses all its water after about an hour's heating at 90-100°. At 150° no formation of BF_3 is observed. Total dissociation takes place at 500° (1 hour). This reaction may be considered a good laboratory method for obtaining pure and dry BF_3. Other experiments were made with mixtures of KBF_4 with $MgCl_2$, $CaCl_2$, $MgSO_4$, and $BaCl_2$. It was found that the dissociation temperatures of KBF_4 are thereby considerably lowered (45.6% KBF_4 dissociated in one hour at 500° in a mixture of 2M KBF_4 with 1M $BaCl_2$). Since $BaCl_2$ is easily dehydrated, this procedure also can

CHEMISTRY, GENERAL (continued)

be recommended as a laboratory source of BF_3. However, its industrial application may present difficulties because of the partial melting of the mixture.

437 The Preparation of Carbon Fourteen Labeled Methane and Carbon Tetrachloride by William H Beamer J Amer Chem Soc 70 3900-3901 (1948) Nov

An efficient method has been developed for the synthesis of carbon tetrachloride labeled with radioactive carbon-14, with a purity greater than 99%. The starting product was $BaC^{14}O_3$, and the following reactions took place:

$$BaCO_3 + H_2SO_4 \rightarrow BaSO_4 + CO_2 + H_2O$$

$$CO_2 + 4H_2 \xrightarrow{\text{Ni-ThO}_2\text{ catalyst}} CH_4 + 2H_2O$$

$$CH_4 + 4Cl_2 \xrightarrow{\text{light}} CCl_4 + 4HCl$$

A sketch of the all-glass vacuum line system for the efficient handling of the volatile compounds is given.

438 Radioactive Diisopropyl Fluorophosphate by Benjamin Witten and Jacob I Miller J Amer Chem Soc 70 3886-3887 (1948) Nov

Diisopropyl fluorophosphate containing P^{32} was synthesized, as was radioactive phosphorus trichloride, starting with radioactive phosphoric acid or potassium dihydrogen phosphate, in which case the yield was 33%. The specific activity of the diisopropyl fluorophosphate was 20 mc/g.

439 Tungsten Fluorides and Related Compounds by Homer F Priest and Walter C Schumb J Amer Chem Soc 70 3378-3379 (1948) Oct

Reacting tungsten dioxide with anhydrous hydrofluoric acid at 500° yielded WOF_2, a gray solid which is chemically inert, resisting alkalies, acids, and even aqua regia. Ignition of this compound at 700° in platinum yields the trioxide. This reaction yielded several by-products, consisting of members of a series of fluotungstic acids, containing tetravalent and hexavalent tungsten. The cubic perovskite structure was revealed by x-ray diffraction. WF_4 was prepared by reducing hexafluoride with benzene in a nickel bomb at 110° over a period of 3-9 days. It is a reddish brown solid, somewhat hydroscopic, hydrolyzed by hot alkali to form tungsten dioxide, and oxidized in the presence of acid to tungsten trioxide. Sectional drawings are given of the nickel bomb.

COSMIC RADIATION AND MESONS

440 About the Positive Excess of the Hard Component of Cosmic Ray by I F Quercia, B Rispoli and S Sciuti Phys Rev 74 1728-1729 (1948) Dec 1 (Letter to the editor)

With the experimental equipment described in a previous letter (Phys Rev 73 516 (1948)), other measurements of the positive excess of the penetrating component of cosmic radiation have been made in flights at 5000 and 7300 m. The data are tabulated and are in agreement with the earlier results. If the multiple generation of mesons is assumed (Lewis, Oppenheimer, and Wouthuysen, Phys Rev 73 127 (1948)), it is noted that the number of mesons from one proton process decreases with decreasing proton energy. This would explain an increase of positive excess with altitude and a decrease with zenithal angle (Ballario, Benini, and Calamai, Phys Rev 74 1729 (1948)). However, if exchange forces are assumed, it is likely that the locally generated mesons do not show any positive excess. This fact would indicate a decrease in positive excess with increasing altitude.

441 Cosmic Magnetism and Cosmic Rays (Magnétisme Cosmique et Rayons Cosmiques) by Alexandre Dauvillier Compt Rend 227 1003-1004 (1948) Nov 15 (In French)

Referring to the presence of heavy, high energy particles is cosmic rays and to the recent discovery of intensive variable magnetic fields in stars of type A, the author sees in these periodically changing magnetic fields the accelerating source responsible for the most important components of

COSMIC RADIATION AND MESONS (continued)

cosmic radiation. A less important part is ascribed to the magnetic fields of the solar and stellar spots accelerating the metal ions of the inner corona. A distinct class of phenomena, such as auroras and the terrestrial magnetism, is caused by the permanent electronic and ionic solar emissions.

442 Disintegration of Negative Mesotrons in Matter (Raspad Otritsatel'nykh Mezotronov v Veshchestve) by Yu G Pliner Priroda 3 45-47 (1948) Mar (In Russian)

This is a non-technical exposition of the discrepancies between the meson theory of intranuclear forces and the recent observations on meson capture by nuclei and meson disintegration. The latest works cited are: Conversi, Pancini, and Piccioni Phys Rev 71 209 (1947); Sigurgeirsson and Jamakava Phys Rev 71 319 (1947); Fermi, Teller, and Weisskopf Phys Rev 71 314 (1947).

443 Explanation of a Group of Experimental Facts by the Existence of an Intermediary Light Particle in Large Showers of Cosmic Radiation (Sur l'explication d'un ensemble de faits expérimentaux par l'existence d'une particule intermédiaire légère dans les grandes gerbes du rayonnement cosmique) by Pierre Auger, Jean Daudin, André Fréon and Roland Maze Compt Rend 226 569-572 (1948) (In French)

The properties of the "λ-meson", a particle previously postulated (Compt Rend 226 , p. 169, 1948) to account for discrepancies between observations and the theory of photoelectronic cascades applied to extensive cosmic ray showers, are further described. The particle has been previously described as possessing a unit charge and having a mass in the range 3-10m_e; this has been deduced from the numerous short, highly ionized expansion chamber tracks which have been observed. The energy losses by ionization and radiation of such a particle are discussed. The latter is calculated from Bloch's formula; the former may be obtained to a first approximation by assuming that for a given velocity the radiation losses vary as the inverse square of the mass of the particle (Daudin, Ann Phys 20 563-584 (1945)). Tabulated data for the masses m_e, $3m_e$, and $10m_e$ are given below.

Mass	E_c(Air)(ev)	E_c(Pb)(ev)	R(cmPb) for $E = E_c$(Pb)	R(cmPb) for $E = E_c$(Air)
1	1.5×10^8	8×10^6	0.4	1.85
3	3×10^{10}	2.8×10^8	10	12
10	1.7×10^{11}	10^{10}	~ 100.4	>100.85

The critical energy at which the radiation losses equal the ionization losses is E_c; the mean range R (in lead) for the different particle masses is given for E_c for air and lead. (The mean ranges in air for particles of E_c(air) energy are 300 m and 6.8 km for m_e and $3m_e$, respectively.) The average course length L in terms of the mean momentum p is calculated from the relationship: $L = tc(pc/mc^2)$, where t is the mean life of the λ-meson; effects due to the disintegration become appreciable for $t \leqslant 10^{-7}$ sec, where L is of the same order of magnitude as R for a particle of mass $3m_e$ in air.

The assumption of the particle postulated is found to account for the following: (1) the median (5-15 cm) region of the absorption curves for particles in extensive showers (Auger, Maze, Ehrenfest, and Fréon, J Phys Théor et App 10 39-49 (1939)); (2) high coincidence counts between counters several meters apart and shielded by 10 cm of lead; (3) the extensive area of showers found by Skobeltzyn (Phys Rev 71 315-317 (1947)); (4) a few mm of lead placed between the counter screens results in an increase in the counts observed (Daudin and Fréon, Compt Rend 214 662-664 (1942); Auger and Daudin, Compt Rend 212 897-900 (1941)); (5) if a 2 cm lead cover is placed over one or more of a group of coincidence counters an increase in counts is observed which disappears at heights greater than 50 m (Auger and collaborators, Revs Mod Phys 11 288-291 (1939)). The last mentioned can be accounted for if the λ-meson is also responsible for the lateral extent of such showers. It is noted that if such particles undergo nuclear interactions it is necessary to assume a larger mass than the value which accounts for the aforementioned observations.

COSMIC RADIATION AND MESONS (continued)

444 An Extension of the Theory of a Particle of $h/2\pi$ Spin Which Permits the Representation of a Meson Having Several Mass States (Sur une extension de la théorie du corpuscule de spin $h/2\pi$ permettant de représenter un meson possédant plusieurs états de masse) by Gérard Petiau Compt Rend 227 825-827 (1948) Oct 27 (In French)

The theory of a particle of spin $h/2\pi$ formulated by de Broglie is extended to the representation of a meson which has several mass states. In de Broglie's theory, the particle postulated results from the "fusion" of two particles of spin $h/4\pi$. The modification of Van Isacker (Compt Rend 224 1761 (1947)), which permits a coupling of all the characteristic quantities of the particle, is introduced in deriving the equations for the meson.

445 The Heavy Component of Primary Cosmic Rays by Phyllis Freier, E J Lofgren, E P Ney and F Oppenheimer Phys Rev 74 1818-1827 (1948) Dec 15

Further evidence (Phys Rev 74 213 (1948)), obtained using photographic emulsions, is presented for the existence of heavy nuclei as components of the primary cosmic radiation. Preliminary results are given for the atomic number distribution of these components. Lower limits of the energies of the particles on entrance into the atmosphere are calculated. These are, in general, above the cut-off imposed by the earth's magnetic field. The mean free path for nuclear collisions is of the order of 14 cm of photographic emulsion. This is longer than that expected from the geometrical cross section and may indicate velocity dependence of nuclear forces. An example of a track that stops in emulsion is shown. This particle gives further evidence for the nuclear character of the rays, because as it slows down it captures planetary electrons and decreases its rate of energy loss. An approximate value of 4 for the hydrogen-helium ratio is reported. 11 figures.

446 Investigation of the Primary Cosmic Radiation with Nuclear Photographic Emulsions by H L Bradt and B Peters Phys Rev 74 1828-1837 (1948) Dec 15

Several methods for determining the range and energy of heavy nuclei found in the primary cosmic radiation are discussed. The application of such methods to a number of tracks from the heavy primary cosmic-ray component in Ilford C_2 emulsions has indicated the presence of nuclei ranging from the neighborhood of carbon in the periodic system to that of iron. Tabulated data are given and some of the tracks obtained are shown. A nuclear explosion caused by the collision of a carbon or oxygen nucleus, having an energy greater than 3 Bev (approximately), with a silver nucleus of the emulsion is discussed. The authors indicate that data on the magnitude of the flux and the distribution of the ranges of the nuclei of the heavy primary cosmic-ray component may give useful information regarding the origin of cosmic rays.

447 The Lifetime of the Heavy Meson by J Reginald Richardson Phys Rev 74 1720-1721 (1948) Dec 1

From data taken on star-producing mesons produced by the 380-Mev α-particle beam of the 184-inch cyclotron, the half life of the star-producing negative mesons for $\pi \rightarrow \mu$ decay was determined as $(7.7\ ^{+2.1}_{-1.5}) \times 10^{-9}$ sec. (The error indicated is the statistical standard deviation.) The mean life was determined as $(1.11 \pm \frac{.31}{.22}) \times 10^{-8}$ sec.

448 Magnetized Stars as Induction Accelerators Producing Cosmic Rays (Namagnichennye Zvezdy kak Induktsionnye Uskoriteli, Sozdayushchie Kosmicheskie Luchi) by Ya P Terletskii Zhur Eksptl i Teoret Fiz 18 479 (1948) May (In Russian)

The recent measurements of magnetic fields of fast rotating stars (Babcock Astrophys J 105 105 (1947) and Phys Rev 72 83 (1947); Blackatt Nature 159 658 (1947)) permit the testing of the hypothesis suggested by the author (Doklady Akad Nauk SSSR 47 104 (1945); Zhur Eksptl i Teoret Fiz 16 403 (1946)). According to this hypothesis, a revolving cosmic body, whose magnetic axis forms an angle with the rotation axis, creates a whirling magnetic field which is able to accelerate charged particles and drive

COSMIC RADIATION AND MESONS (continued)

them away from the central body along a spiral path. The magnetic field at the surface of 78 Virginis, the most completely studied star, is 1500 gauss (50 gauss on the sun). Assuming the same angle 6° between the two axes as it exists on the sun, the energy of the particles is found to be of the order of 10^{12} ev (the average energy of cosmic rays is 10^{10} ev). Elsewhere (Vestnik Moskovskogo Gosudarstvennogo Univ 1 75 (1948)) the author has shown that his hypothesis explains the fundamental properties of the primary component of the cosmic rays.

449 Masses of Mesons by R Fürth Nature 162 772-773 (1948) Nov 13

The author applies his "hypothesis of elementary indeterminacy" (Z Physik 57 429 (1929); Naturwissenschaften 17 688, 728, (1929); Physik Z 30 895 (1929)) to the determination of the mass of the meson relative to the proton mass. Previously this method was used to predict the neutron mass before its discovery (Fürth, Z Physik 85 294 (1933); Glaser and Sitte, Z Physik 87 674 (1934)). By equating his previous value for the neutron radius to the range of the field surrounding the neutron (using Yukawa's theory), the mass of the π-meson is determined as 293 electronic units, which compares well with the experimentally established value of 260 ± 40 (Goldschmidt-Clement, King, Muirhead, and Ritson, Proceedings of the Physical Society 61 183 (1948)).

The analogy between the π-meson and the photon is discussed, the production of such a meson by a fast nucleon being considered as the analog of the Bremsstrahlung of an electron. The author suggests that the decay of a π-meson into a μ-meson is analogous to the Compton effect, i.e., that the collision of a neutron and a π-meson results in the production of a μ-meson. The remainder of the energy is emitted as a neutral particle of small rest mass, i.e., a neutretto, neutrino, or photon. By applying this concept, a ratio m_π/m_μ of 1.32 is obtained, which agrees with the value of 1.35 recently reported at the Bristol Symposium on Cosmic Radiation. It is noted that repetition of such a "scattering" would result in smaller and smaller mesons, which might account for the small mass mesons reported recently by cosmic ray workers. The author concludes that if the analogy between photons and mesons is correct, then all mesons are the same type of fundamental particle, and a continuous spectrum of meson masses over a wide range both below and above that of the π-meson should exist.

450 On the Differential Spectrum of Low Energy Mesons (Sur le Spectre Différentiel des Mésons de Faible Énergie) by Anatole Rogozinski and Marc Lesage Compt Rend 227 1027-1029 (1948) Nov 15 (In French)

Using a counter telescope with 4 Pb filters, the authors examined the little known region in the meson spectrum which corresponds to momenta less than 800 Mev/c. The curve obtained shows a minimum at about 450 Mev/c.

451 On the Energy of Cosmic Radiation Allowed by the Earth's Magnetic Field by M S Vallarta Phys Rev 74 1837-1840 (1948) Dec 15

Useful information on the energy of the cosmic radiation allowed through the earth's magnetic field has been plotted in the form of curves. The proton energy allowed by the earth's magnetic field as a function of geomagnetic latitude are shown for the following directions: vertical, 45° west, 45° east, 45° north, and 45° south. In addition, curves showing the distance and angle corrections for the longitude effect are shown for the following latitudes: the geographic equator, 20° north, and 40° north.

452 On the Light and Heavy Mesons by J Leite Lopes Phys Rev 74 1722-1723 (1948) Dec 1 (Letter to the editor)

Recent calculations by Tiomno and Wheeler which indicate a method of obtaining the right order of magnitude of the life times for β-decay of μ-mesons (Revs Mod Phys (in press)) and for the K-capture of these mesons by nuclei (Private communication) are interpreted. Tiomno and Wheeler assumed a Fermi-coupling between μ-mesons and leptons as between nucleons and μ-mesons. The author indicates a reasonable interpretation of the so-determined nucleon-μ-meson coupling constant in terms of a nucleon-π-meson coupling assumed to be responsible for nuclear forces. A coupling between the

COSMIC RADIATION AND MESONS (continued)

two meson fields is then required by the μ-decay of heavy mesons and will be of the same nature as the nucleon-π-meson coupling. This results in a μ-meson-nucleon interaction analogous to the potential energy of nucleons as deduced from the current meson field theory. The following estimates were obtained for the lifetime of a π-meson at rest which disintegrates into a μ-meson and a neutral fermion: (I) $\tau_{\pi_\mu} \sim 4 \cdot 10^{-9}$ sec, for $m_\pi/m_\mu \sim 1.65$ (fermion = μ_0-meson with mass $\sim 100 m_e$); (II) $\tau_{\pi_\mu} \sim 0.4 \cdot 10^{-9}$ sec, for $m_\pi/m_\mu \sim 1.32$ (fermion = neutrino).

453 On the Positive Excess of the Meson Component at Sea Level under Different Zenithal Angles by C Ballario, M Benini and G Calamai Phys Rev 74 1729-1730 (1948) Dec 1 (Letter to the editor)

Using an experimental setup similar to one recently employed (Bernardini, Conversi, Pancini, Scrocco and Wick Phys Rev 68 109 (1945)), data were taken on the positive excess of the meson component of cosmic radiation at sea level for different zenith angles. The relative magnitudes of the positive excess for 0°, 30°, 45°, and 60° between the telescope axis and the vertical, computed using Wick's theory, are compared with values obtained from the data; tables of the raw data and of the positive excess calculations are shown. The experimental values decrease with increasing angle, while the theoretical values do not. The discrepancy is interpreted as indicating that the positive excess is not uniformly distributed in the meson energy spectrum; instead it decreases with increasing initial meson energy. In addition it is noted that for high energies it might be necessary to consider a contribution caused by non-ionizing radiation.

454 Principal Characteristics of the Various Mesons (Principaux Caractères des Divers Mésons) Atomes 3 204 (1948) June (In French)

Characteristic data on the various types of mesons are presented in tabular form. The charge, mass, half-life, method of observation, and theories of origin and disintegration are included.

455 Properties of Cosmic Ray Penetrating Showers by John Tinlot. MIT (Office of Naval Research Contract) Technical Report No. 18 nd 47p (NP-518)

The variation of the frequency of occurrence of penetrating showers was measured as a function of atmospheric depth from an altitude near sea level (250 feet or 1030 g/cm^{-2}) up to 30,000 feet, (310 g/cm^{-2}). The definition of the penetrating showers (as a group of two or more associated penetrating particles) includes two phenomena, the showers locally produced in the block of lead, and the showers originating in the atmosphere. Separation of the two effects was accomplished by the use of an unshielded group of counters placed near the detector. Atmospheric showers were expected to discharge the unshielded counters, while locally produced showers had a small probability of doing so. Measurements with the penetrating shower detector (which detects both types of showers) indicate an exponential variation with atmospheric depth yielding a mean path of 120 g/cm^{-2}. It is clearly shown that the effects of electrical interference, chance coincidences, and cascade air showers are negligible compared to the penetrating showers. Multiple knock-on processes affect the measurements to an appreciable extent at the lowest altitude (1030 g/cm^{-2}), but this effect is calculable at this altitude and negligible at altitudes of 9500 feet (725 g/cm^{-2}) or higher. The ratio of locally produced to atmospherically produced penetrating showers is found to be about 10:1 at altitudes up to 14,000 feet (625 g/cm^{-2}). Thus the locally produced penetrating showers give by far the largest effect. The atmospheric penetrating showers, in over half the cases, are established to have a high density of soft particles (130/m^2 or greater), and are therefore identified as dense air showers containing penetrating particles.

456 Scattering of Particles in Air Showers by L Eyges Phys Rev 74 1801-1806 (1948) Dec 15

The radial distribution of singly scattered particles in air showers is discussed. The probability $P(x')dx'$ that a singly scattered particle is found in the annular ring between x' and $x' + dx'$ is

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$P(x')dx' = 0.16(dx'/x'^3)$, where x' is the "Moliere unit." (In Cosmic Radiation, ed. Heisenberg, New York, Dover Publications, 1946, p 26.) In the deduction of this formula Belenky's expression for the mean square length of a shower (J Phys USSR 8 305 (1944)), which remains valid below the critical energy, is evaluated. The main process contributing to particles at large distances from the shower axis involves the radiation, and subsequent rematerialization, of electrons below the critical energy.

457 Search for Photons from Meson-Capture by O Piccioni Phys Rev 74 1754-1758 (1948) Dec 15

The possibility that photons having energies in the neighborhood of 50 Mev are associated with the stopping of mesons in iron has been investigated. An anticoincidence tray arrangement was used which selected events corresponding to the stopping of a meson in the iron absorber; the geometry used was of the type which has been widely used in slow meson experiments (Rasetti, Phys Rev 60 198 (1941)). Tabulated data are shown which indicate that such photons are not produced either by negative meson capture or by the free decay of positive mesons.

458 Some Properties of Penetrating Rays in Auger Showers (Quelques proprietés des rayons pénétrants dans les gerbes d'Auger) by Jean Daudin Compt Rend 227 1094-1096 (1948) Nov 22 (In French)

Rays penetrating 15-20 cm of Pb produced coincidences in 2 parallel counters placed on an horizontal plane and connected with 2 unshielded counters a few meters away. The coincidences (40%) are considerably more frequent than those observed under the same conditions with ordinary mesons (7%). When each of the 2 shielded counters was wrapped with 4 mm of lead sheet, the number of coincidences decreased 40% ± 6%. This should indicate the presence of a soft radiation originating in the neighborhood of the counters. The penetrating particles studied are too productive of showers to be identified with ordinary isolated mesons; on the other hand, they are associated with too many soft secondaries to be classed as shower mesons. The existence of a particle with a mass intermediate between that of a meson and of an electron would best account for the facts observed.

459 The Structure of the Large Cosmic-Ray Air Showers by Robert W Williams Phys Rev 74 1689-1706 (1948) Dec 1

A series of experiments on cosmic-ray air showers is described in which 27 showers of more than 10^{16} ev total energy were recorded. Four "fast" ionization chambers, with electronic coincidence and photographic recording of pulse height, were used to investigate the structure of these showers in detail at mountain altitudes. The experiments show that the showers have the structure characteristic of electron cascades. There is no evidence for unusually narrow showers. If the showers originate from the decay of neutral mesons, these mesons must be produced either singly, or in groups whose total angular divergence is not greater than $\sim 10^{-4}$ radian.

The frequency of occurrence of showers which have a particle density greater than ρ particles per square meter at the point of observation is shown to be $1.05(460/\rho)^{1.5}$ hr^{-1}, $300 < \rho < 2000$ particles/m^2, at 3050-m elevation. This frequency is also given for two points of observation with various distances separating them. Data on the angular distribution of the showers at 3050 m and the altitude variation between 3050 m and 4300 m are presented. The results of some theoretical calculations on altitude and angular variation are given, but they are not sufficiently accurate to indicate clearly the nature of the primary event which causes these showers. Absolute rates for the number of showers of a certain size and for the number of primary events are presented.

460 Studies of Bursts at Sea Level by H Carmichael Phys Rev 74 1667-1688 (1948) Dec 1

Data obtained in some 2000 hours of photographic registration of cosmic-ray ionization bursts at sea level (some of which has been published previously) are discussed. The measurements cover a very wide range of burst size (factor 2000) in two ion chambers of volumes 175 and 1.1 liters, with

COSMIC RADIATION AND MESONS (continued)

argon, nitrogen, and hydrogen gas fillings at pressures ranging from 1.5 to 87 atmospheres. When the ion chambers (thin-walled) are unshielded the bursts are very clearly separable into a component resulting from heavily ionizing particles from cosmic-ray induced nuclear disintegration and a component resulting from the extensive cascade showers from the atmosphere. The number-size distributions to be expected in the ion chambers from single protons and α-particles produced by nuclear disintegrations are calculated on the assumption that these particles have the energy spectrum given by Bagge. The effect of columnar recombination at high pressures in nitrogen and argon is discussed and allowed for. The agreement obtained between the calculated curves and those observed shows that the interpretation of this component as chiefly caused by single heavily ionizing protons and α-particles is probably correct. Some very rare bursts of anomalously large size are found under moderate thicknesses of lead. The experimental results of others are reviewed, and detailed comparisons are made.

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

461 The Application of Electron Multiplier Tubes in the Measurement of X-Ray Beam Intensities and in the Determination of Crystal Structure by G Papp and K Sasvari J Applied Phys 19 1182-1183 (1948) Dec

The application of the electron-multiplier tube previously described (Z Physik 117 227 (1941)) to the measurement of X-ray beam intensities and the determination of crystal structures is discussed. The number of pulses of the tube can be used to measure X-ray intensities, the tube being capable of measuring intensities producing 1 pulse per hour up to 10^4 pulses per second. Using Mo K_α radiation, the quantum efficiency was determined as 2.75×10^{-3} electron per photon. At a supply voltage of 3060 volts a multiplication of 1.46×10^{-9} was obtained. Thus, when compared with a perfectly absorbing ionization chamber, the electron multiplier tube will give a current 10^4 as large for a given intensity of radiation. The value of substituting the latter for the former in an X-ray spectroscope is suggested. Further investigations are being conducted on the application of such tubes to the study of the fine structure of surfaces and the examination of materials.

462 Crystal Structure of Element 43 by Rose C L Mooney Acta Cryst 1 Part 4 161 (1948)

This article is based upon MDDC-1520. An abstract of the document appeared in Abstracts of Declassified Documents 2 9 (1948) Jan 15

463 The Diffusion of X-Rays Through a Partially Ordered Lattice (La Diffusion des Rayons X par un Alliage Partiellement Ordonne) by A Guinier and R Griffoul Acta Cryst 1 Part 4 188 (1948) (In French)

The diffuse reflections of x-rays from a partially ordered lattice have been computed for a special case in terms of a single parameter, the degree of the short-range order. In the case of a three dimensional lattice the results obtained are applicable only in particular cases; in general, the order cannot be defined by a single parameter, and it is necessary to specify the degree of both short- and long-range order.

464 Electron Diffraction from Anthracene with Special Reference to the Diffuse Background by J Skrebowski Proc Phys Soc 61 430-438 (1948) Nov 1

The object of the research was to examine the diffuse pattern obtained when an electron beam is transmitted through a crystal of anthracene. A special camera adapted for low temperature work is described. It has been found that the diffuse pattern has a fine structure which is more apparent in the case of thick crystals. The changes in intensity of the diffuse pattern with temperature have been established experimentally and it is shown that the phenomenon of the diffuse scattering is analogous to that found in X-rays. Several patterns are shown.

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE (continued)

465 Experimental Study of Electron Densities in Crystals. Part I. Electron Density of Aluminum by N V Ageyev and D L Ageyeva Izvest Akad Nauk SSSR Otdel Khim Nauk No. 1 17-28 (1948) Jan-Feb

An experimental determination of the curve of atomic factor of scattering for aluminum was made, with the subsequent calculation of electron density distribution in the directions [001], [011], and [111] by Fourier's tripple series method. A new method is shown for the computation of the optimal temperature correction and of the extrapolation back to the temperature of the experiment, thus giving the distributions of the electron densities at 20°. It is shown that in metallic aluminum the atom is incompletely ionized.

466 Method and Apparatus for Producing Electron Diffraction Spectra by Gerald L Simard, Stamford, and Charles R Stryker, Greenwich, Conn., assignors to American Cyanamic Company, New York. U S Patent No. 2,457,092 Dec 21 1948

An improved method of obtaining and recording electron diffraction spectra has been developed along with an improved apparatus for performing the task. By introducing a lens capable of magnifying the image on the photographic plate to any desired degree, between the specimen and photographic plate, the rings from lattice spacings up to 40 A are brought out of the central spot. Up to now, a lattice spacing of 5 A had been the upper limit, but the new method permits investigation of certain inorganic and organic compounds that could not be investigated up to date.

467 On the Compton Scattering in Lithium by A Barkhatov Zhur Eksptl i Teoret Fiz 18 609-613 (1948) July (In Russian)

A distribution function of the impulses of the conductivity electrons was used to determine the width of the Compton line of lithium. This distribution function takes into account the interaction between the electrons and the lattice structure. The result shows a wider line than that obtained from Fermi's distribution function for free electrons. Equations of the intensity curve of the Compton line in lithium are: (1) using Fermi's distribution function (free electrons), $Y_f = 1 - l^2/l_0^2$; (2) using author's distribution function (interaction between electrons and the lattice), $Y = 0.599\,[1 - l^2/l_0^2 - 0.052\,(1 - l^2/l_0^2)^2] + 0.004$, where l is the distance (in atomic units) from a point in the widened Compton line to the simple Compton line, and $l_0 = lp_0/p$, p being the conductivity electron impulse corresponding to l, and p_0 being the maximum impulse which in this case is equal to 0.598.

468 An X-Ray Diffraction Photometer by C L Christ, E F Champaygne, R Bowling Barnes and C F Salzman Jr Rev Sci Instruments 19 872-878 (1948) Dec

An automatic recording instrument which permits the direct comparison of the X-ray diffraction patterns of two separate powder samples has been constructed through suitable modification of a commercial North American Philips Geiger counter X-ray diffraction spectrometer. Some of the experimental results obtained with the new instrument are shown, and possible applications to qualitative and quantitative analysis indicated. A circuit diagram is shown along with a scale drawing and photographs of the sample holder used. Diffraction patterns of the following are shown: anatase and anatase-rutile mixture, calcite and calcite-aragonite mixture, PbO, Pb_3O_4, PbO-Pb_3O_4 mixtures. The effect of increasing the concentration of one of the mixture components upon the line height is illustrated.

DEUTERIUM

469 Thermodynamic Functions for Tritium Deuteride. The Dissociation of Tritium Deuteride. Equilibria among the Isotopic Hydrogen Molecules by W M Jones. AECD-2427 (LADC-589) Oct 27 1948 Decl Dec 27 1948 16p Proposed for publication in J Chem Phys Document for sale by AEC

The heat capacity, entropy, internal energy and free energy are calculated to 2500°K for tritium deuteride. The dissociation of tritium deuteride is considered. The percentage of dissociation of tritium and deuteride and other hydrogens at a total pressure of one atmosphere calculated from the equilibrium constant. Tabulations of data are included. Equilibria of the isotopic hydrogens among themselves are calculated.

470 Deuterium (pn) Threshold by R V Smith and H T Richards Phys Rev 74 1871-1872 (1948) Dec 15 (Letter to the editor)

Using the Wisconsin electrostatic generator a quick search for the threshold of the deuterium pn reaction (in which two protons are also given off) has been made using a long, small diameter hydrogen recoil counter as a neutron detector. The reaction is of particular interest since the Q of the reaction is the binding energy of the deuteron. The neutron yield curve which is shown indicates a cross section of about 10^{-30} cm^2 for the reaction at proton energies of 3.4 Mev. The statistics were not good enough for extrapolation to the threshold; however, future investigations along these lines will be made.

FLUOROCARBONS

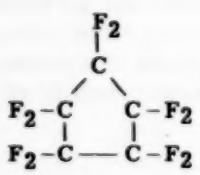
471 Physical Properties of Chlorotrifluoroethylene Polymers. III. Density and Viscosity of Chlorotrifluoroethylene Polymers as a Function of Temperature by J L Gabbard, R Alvarez, J F Dietrich and W W Lemarr. AECU-34 (K-328) Dec 31 1948 13p

The densities and viscosities of three different lots of chlorotrifluoroethylene polymers and a residue and distillate from the molecular distillation of one of these lots were investigated as a function of temperature. The data are tabulated, and equations and graphs showing the relationships are presented. The viscosity index for these oils is also given. For purposes of comparison, an equal number of samples of fluorolube oils with an approximate composition of $C_{21}F_{44}$ were investigated.

472 Addition of Organic Molecules to Fluoro-olefins; Addition of Some Alcohols and Amines to Certain Fluoro-olefins — June 15 1947 to June 15 1948 by Paul Tarrant. University of Florida (Office of Naval Research Contract) nd 23p (NP-506)

This report deals with the preparation of aliphatic fluoro-compounds, their dehalogenation, some reactions of the olefins and the resulting products formed by additions to the olefins. The work is divided into two categories: 1) the preparation of the olefins, and 2) their reactions. This division was made because the fluorinations require special apparatus and techniques which are peculiar to processes for the introduction of fluorine into organic molecules while the additions follow lines usually employed in ordinary synthetic organic work. The present research was limited to the reactions of fluorochloroethylenes.

473 Fluorocarbon Compound by Joseph H Simons, State College, Pa., assignor to Minnesota Mining & Manufacturing Company, St. Paul, Minn. U S Patent No. 2,456,028 Dec 14 1948

A volatile liquid alicyclic fluorocarbon compound, C_5F_{10}  has been prepared

FLUOROCARBONS (continued)

by reacting carbon and fluorine between 350° and 385°C in the presence of mercury fluoride. The compound is odorless, colorless, non toxic, non corrosive, chemically inert, thermally stable, and useful as an extinquisher, low boiling point solvent (boiling point is 21-22°C).

474 Infra-red Spectra of Fluorinated Hydrocarbons. Part III by H W Thompson and R B Temple J Chem Soc 1432-1436 (1948) Sept

The authors have measured the infra-red absorption spectra of fully fluorinated cyclohexane, methylcyclohexane, n-pentane and 2,3-dimethylpentane, o-, m-, and p-fluoro- and 2,4-difluoro-toluene; benzotrifluoride, m- and p-fluoro- and 2,5-difluoro-benzotrifluoride. Complete spectra are reproduced and tables of frequencies are presented. The application of these data to analytical work is discussed.

475 Method of Making Fluorocarbons by Joseph H Simons, State College, Pa., assignor to Minnesota Mining & Manufacturing Company, St. Paul, Minn. U S Patent No. 2,456,027 Dec 14 1948

A process is described for producing substantial yields of new fluorocarbons containing three or more carbon atoms in the molecule. Carbon and fluorine are reacted between 200° and 600°C smoothly and non-explosively in the presence of fluorides of mercury, antimony, aluminum, and iron. The compounds are thermally stable up to 1000°C, colorless in the liquid and gaseous form, and white or colorless in the solid form, odorless, non toxic, non corrosive, and relatively inert. Cyclic as well as aliphatic compounds have been prepared, isolated, and the melting points, boiling points, densities, heats of vaporization, and vapor pressures determined. The compounds are C_3F_8, C_4F_{10}, C_5F_{10}, C_6F_{12}, and C_7F_{14}.

476 Minnesota Mining and Mfg. Co. Making Fluorocarbons by Economical Electrochemical Process Chem Eng News 26 3832 (1948) Dec 27

The first commercial production of solid, liquid, and gaseous fluorocarbons has been undertaken by the Minnesota Mining and Manufacturing Company of St. Paul on a pilot plant scale and will be expanded into semiworks scale. Low-voltage electrolysis is used, reducing the cost of manufacture.

477 Organic Compounds of Fluorine by F Smith Ann Reports Prog Chem (1947) 44 86-119

The author reviews the work done in the organic chemistry field using fluorine. Three ways may be used to introduce the fluorine into organic substances by direct fluorination: the vapor phase, liquid phase, and solid state treatments. The more stable hydrocarbons give better yields (aromatic hydrocarbons being better than paraffins and partly fluorinated hydrocarbons giving still better yields). Fowler's (Ind Eng Chem 39 343 (1947)) work is given, and it is seen that this method of fluorocarbon production, using CoF_3, gives a better yield than the indirect catalytic fluorination methods. The mechanism of addition and substitution, it is suggested, is fundamentally similar to analogous chlorinations. The properties of fluorocarbons are also discussed. It is seen that progressive replacement of hydrogen by fluorine in a hydrocarbon results in an increase in the boiling point, reaching a maximum and then falling to a minimum value, the boiling point of the fluorocarbon. In the case of aromatic substances, the hydrogen replacement causes small change in boiling points. It is noted that fluorocarbons have abnormally high densities, low refractive indices and surface tensions, high viscosities and steep viscosity-temperature curves. The parachor for F in fluorocarbons is about 24.5. Space is also devoted to a discussion of partly fluorinated compounds, their production, and their properties as well as fluoro-olefins and perfluoro-acids and their derivatives. 184 references.

FLUOROCARBONS (continued)

478 The Relative Reactivities of Some Substituted Benzyl Fluorides by William T Miller Jr and Jack Bernstein J Amer Chem Soc 70 3600-3604 (1948) Nov

The authors determined the relative reaction rates of substituted benzyl fluorides with alcoholic sodium ethoxide, aqueous alcoholic sodium hydroxide, and aqueous hydrochloric acid. The benzyl fluorides showed a lower order of reactivity than the other benzyl halides, but the reaction mechanism and relative effects of substituted groupings were comparable. The authors proposed a mechanism involving hydrogen bonding with fluorine attached to carbon in order to explain the acid-catalyzed replacement of fluorine, which occurs in contrast to the behavior found for other benzyl halides.

479 2-Butoxyethyl Fluoroacetate by Ingenuin Hechenbleikner, Norwalk, Conn., assignor to American Cyanamid Company, New York. U S Patent No. 2,456,586 Dec 14 1948

The compound 2-butoxyethyl fluoroacetate may be prepared in good yield by reacting together ethyl fluoroacetate and 2-butoxyethanol in the presence of p-toluene-sulfonic acid.

480 The Vapor Pressures of Forty-one Fluorine-containing Organic Compounds by C Ernst Redemann, Saul W Chaikin, Ralph B Fearing, George J Rotariu, Joseph Savit and Drusilla Van Hoesen J Amer Chem Soc 70 3604-3607 (1948) Nov

In order to estimate their maximum potential toxic action, the volatility of forty-one fluorine-containing organic compounds was measured between 0 and 60°C using the method of Bent and Francel (J Amer Chem Soc 70 634 (1948); Redemann, Chaikin, and Fearing, J Amer Chem Soc 70 631 (1948)). The vapor pressures were calculated and two-constant logarithmic equations were developed to express the volatility and vapor pressure of these compounds.

GEOPHYSICS

481 Lead Isotopes and the Age of the Earth by Harold Jeffreys Nature 162 822-823 (1948) Nov 20

Using A. O. Nier's (J Amer Chem Soc 60 1571 (1938); Phys Rev 60 112 (1938)) data on the ratios of the abundances of isotopes of lead from a considerable number of ores, and starting with Holmes's (Nature 157 680 (1946); 159 127 (1947)) discussion in which the latter used the variation in abundance to derive an estimate of 3,350 million years for the age of the earth, the author has arrived at an age of approximately 1,340 ± million years by using refined statistical considerations and increasing the estimated uncertainty.

482 The Radium Content of Varved Clay and a Possible Age of the Hartford, Connecticut, Deposits by W D Urry Amer J Sci 246 689-700 (1948) Nov

The radium content of the summer and winter portions of the varves in the clay deposits at Hartford, Connecticut, vary rhythmically. When the radium contents of the summer and of the winter portions are plotted against time as measured by the varve count, the curves exhibit slopes of opposite sign. The total radium content of any varve, however, is practically constant. These phenomena may be due to a disturbance of the radioactive equilibrium but this hypothesis, while plausible, is far from proved. A greater concentration of the uranium relative to ionium in the winter clay than in the summer clay would explain these phenomena. Such a disturbance of the equilibrium provides a means of determining the age of the deposits. On this basis, one derives a tentative figure for the age of the Hartford clay (varve 3700) of 18,000 years. The hypothesis of a disturbance of radioactive equilibrium is supported by the fact that the analyses of the summer and winter curves which are completely independent give very nearly the same age.

GEOPHYSICS (continued)

483 Relative Abundances of Potassium and Argon in the Earth's Surface Materials by J H J Poole Nature 162 775-776 (1948) Nov 13

Taking a value of 2.4×10^9 years as the age of the earth's crust, and using the recent value obtained by Bleuler and Gabriel (Helv Phys Acta 20 67 (1947)) for the half-life of K^{40}, the author calculates the relative amounts of K^{40} and argon which should be present in the surface materials of the earth and compares these with an estimate of the actual relative abundances. The theoretical abundance is much higher than that actually observed, and the author concludes either that present estimates of the age of the earth are too great by a factor of two or else that the value used for the half-life of K^{40} is incorrect. The possibility of error in the values used in calculating the relative percentages of argon and K^{40} now present is noted.

GRAPHITE

484 Carbon and Graphite for the Chemical Engineer by C L Bodvan-Griffith Ind Chemist 24 666-674 (1948) Oct

A review is made, in general terms, of the part carbon plays in the chemical industry, particularly in regard to its application as refractory material, linings for corrosive processes, use as bearings, and use as abrasion resistant material. Tables are given listing physical and chemical properties of carbon, graphite, and carbon cements.

485 The Vapor Pressure and Melting Point of Graphite by Leo Brewer J Chem Phys 16 1165-1166 (1948) Dec (Letter to the editor)

The author indicates that objections by Long (J Chem Phys 16 1087 (1948) Nov) to a heat of sublimation for graphite of 170 kilocalories, an atmospheric sublimation point of around 4600°K, or a melting point of 5000°K, as given by Brewer, Gilles, and Jenkins (J Chem Phys 16 797 (1948)) do not hold, due to Long's use of faulty data.

HEALTH PROTECTION

486 Volume XX Chapter III - Protective Measures for Personnel by J J Nickson. AECD-2424 (CH-3763) Dec 13 1946 Decl Dec 16 1948 62p For publication in NNES

The problem of protective measures for personnel was increased greatly by the increase in the number of individuals potentially exposed and in the amount of the radioactive materials handled. In general, the solution of the problem of protection lay primarily in the proper training of the worker who was to handle radioactive materials. From a physical point of view the use of shielding to absorb external radiation and the utilization of measures to prevent internal disposition of radioactive materials were of prime importance. Protection from contamination of the skin with elements radiating alpha particles was of importance primarily as a means of preventing the ingestion of such radioactive materials. Control of radioactive materials that may get into the body and continue to irradiate the person indefinitely was even more difficult than the control of radiation originating outside of the person. For the most part ingestion of radioactive materials has not presented a serious problem. Fortunately, many of the materials handled are very poorly absorbed from the gastrointestinal tract. It was important, however, to minimize the possibility of ingestion by prohibiting smoking, eating and drinking in work areas, and by keeping the hands clean. The absorption of radioactive materials through breaks in the skin must be prevented. Experience has shown that work clothing should be provided to all workers handling radioactive materials. Disposal of unwanted radioactive substances has been, and continues to be a major problem. Appendices are added on general rules and procedures concerning activity hazards, definition of terms, description of equipment, and references to techniques and procedures.

HEALTH PROTECTION (continued)

487 Health of Workers Exposed to Sodium Fluoride at Open Hearth Furnaces. Public Health Bulletin No. 299 Washington D C United States Government Printing Office (1948) 64 p

This study, made by the Industrial Hygiene division of the Public Health Service in 4 steel plants, revealed no significant physical defects or laboratory and x-ray examination findings that could be linked directly to the use of sodium fluoride. It appears that sodium fluoride does not constitute a health hazard under the conditions of this study.

488 Preventive Medicine in the Atomic Age by W C Cox Bull U. S. Army Med Dept 8 862-876 (1948) Nov

This is a general treatment of preventive medicine. In the section on radioactive isotopes the problems of the preventive medical officer and the health physicist of the communities in which radioactive isotopes are used are given as the (1) reasonableness of the radioactive isotope research, (2) provisions for the safe handling of the radioactive material, (3) health protection of the workers, (4) methods of storage of the radioactive material, (5) methods of waste disposal, (6) safety methods used in shipment of radioactive materials, and (7) provisions for replacement, periodic, and terminal health examinations of the workers and the records of daily and total exposure to radioactive substances. Provided that waste disposal is conducted in a satisfactory manner, the presence of a plant using radioactive isotopes is of no danger to a community.

489 Protection from Atomic Radiation by K Z Morgan Ordnance 33 182-184 (1948) Nov-Dec

The author reviews in a brief general way the duties of a health physicist in connection with the radiation dangers. The various safety meters and the means for making radiation surveys are mentioned. Particular emphasis is made of the great need for trained health physicists.

490 Protection Requirements of One-Million-Volt (1-Mv) and Two-Million-Volt (2-Mv) Roentgen-Ray Installations by Carl B Braestrup and Harold O Wyckoff Radiology 51 840-848 (1948) Dec

Data are presented here for the computation of concrete protection in the primary beam for 1- and 2-Mv roentgen rays. It is pointed out that considerable saving in weight of concrete can be obtained by using ground-floor or isolated locations for the installation. Information is also presented on the secondary protection requirements. For the present installation, it is necessary to protect against the radiation transmitted through the housing rather than that scattered 90° from the main beam. It is suggested that this housing protection be increased by another factor of 10. The scattered and transmitted intensities would be of the same order. For an estimated 100-pound increase in the tube-housing weight, the wall thickness may be reduced by the order of 6 inches of concrete.

491 Radiation Shielding Problems in Health Physics by K Z Morgan J Southeastern Research 1 6-10 (1948) Jan

Some of the damage resulting from a radiation exposure depends not only upon the total exposure but also upon the rate at which the exposure is received. The area of the body exposed, the energy of the radiation used, and the specific ionization are other important factors in determining the maximum permissible exposure. The minimum safety factor ordinarily applied to maximum permissible exposure levels is ten. It was originally believed that there was such a safety factor for the commonly recognized, acceptable level of 0.1 microgram of radium fixated in the body or the 0.1 roentgen exposure to X and gamma rays per day, but more recent biological data indicates that probably this is not the case. The first requirement of a radiation shield is that is produce enough attenuation of the radiation passing through it (and of the radiation produced in it) to offer the desired protection of personnel and equipment. Another requirement of a shield and its

HEALTH PROTECTION (continued)

associated parts is that it prevent not only the radiation but also radioactive gases, fumes and dusts from escaping into areas where damage may result. In some cases the sources of radiation are sealed in metal jackets or glass ampules. It is obvious that every effort must be made to prevent the radioactive contamination of a shield and if such contamination is possible, the surface material of the shield should be such that it can be decontaminated in a minimum time with the smallest effort and with a negligible exposure to persons. There are many other requirements of a shield, such as radiation resistance, general durability, strength, low weight and cost.

492 What the Fire Service Should Know about the Atomic Bomb Fire Engineering 101 674-678 and 718 (1948) Oct

The need for better fire and radiation protection against the atomic bomb is emphasized. The various effects of an atomic bomb explosion are also discussed in a general manner.

INSTRUMENTS

493 An Improved Fluorophotometer by C B Pickle. AECD-2433 (MonP-222) Oct 1 1946 Decl Dec 22 1948 14p Document for sale by AEC

The fluorophotometer as developed is a physical-electronic instrument, consisting of a mercury lamp as a source of ultra-violet light, an optical system, an electron multiplier type of phototube, and an electronic circuit for recording. Readings are by visual observation of a 50 microampere meter with a five inch scale. Samples to be read are inserted into the system on a slide that accommodates one standard and 9 samples. The slide can be inserted and removed without room light reaching the phototube. The instrument was constructed along the simplest possible lines to give ease of operation and maintenance. The bakelite box housing the light source, the optical system and phototube, the single covered chassis of the electronic section, the transformer for the mercury lamp, and the four by four by two inch control box are mounted on a 22 by 33 inch board. Maximum height above the board is the bakelite box that stands 22 inches high.

494 The Development of High Temperature Thermocouples; Report Memorandum No. 8 July 9 through August 19, 1948 by Gary Steven, R M Curcio and Walter C Troy. AECU-42 (NEPA-729) Aug 19 1948 3p

A G. E. high frequency oscillator has been put into operation and an induction furnace for continuous operation at high temperatures has been built. A 100 hour run at 2000°C with a W (thoriated)/60% Rh, 40% Ir thermocouple has been completed. A periodic check of the thermal e.m.f. calibration curve was made all during the run.

495 A Null-Reading Fluxmeter by C C Lauritsen and T Lauritsen Rev Sci Instruments 19 916 (1948) Dec

A simple null-reading fluxmeter which has been used in connection with relative magnetic field measurements in an iron-core spectrograph is described. To measure the field strength, the current required to hold a coil in a specified orientation against a constant torque is measured. The construction details are discussed and a diagram is given, as well as a description of the operation of the fluxmeter. With a magnification of about five, a displacement of a few hundredths of a millimeter, or about 0.03% of the full rotation can be detected. The quartz fiber, which is cemented to the bobbin on which the coil is wound and which serves as an indicator, can be oil-damped at its end and thus eliminate some of the effects of extraneous vibrations. After a year of usage, less than 0.2% change in calibration was observed.

496 Radioactive Electronic Detector as Employed in Seederer-Kohlbusch Microbalance by Irving Feuer Analyt Chem 20 1231-1237 (1948) Dec

A new type of microbalance, making use of ionization of gas through radiation from radioactive substances has been constructed and is explained in detail in this paper. The balance has a

INSTRUMENTS (continued)

capacity of 25 to 50 grams per pan, little change of sensitivity with varying load, short weighing periods, an external electrical reading device which can be read easily, and a sensitivity of at least 1 microgram per mm deflection on a spotlight galvanometer. Schematic diagrams as well as circuit diagrams and sensitivity load curves are presented, and the various systems (rider, damping, knife-edge, pan and beam arrestment) are described.

ISOTOPES

497 A Neutron-Capture Theory of the Formation and Relative Abundance of the Elements by R A Alpher Phys Rev 74 1577-1589 (1948) Dec

On the basis of the inverse relationship between the relative abundance of nuclei and their neutron capture cross sections, a non-equilibrium theory of the formation of the elements is developed in which the elements are built up by a process of successive neutron captures. The coefficients in the equations of this theory involve the neutron-capture cross sections of the elements, and for this reason relationships between capture cross sections, atomic weights, and neutron energies are obtained from available data.

According to this theory, the primordial material was a gas of neutrons only. As the universe expanded, neutrons decayed to protons and electrons; the capture of neutrons by protons then led to deuterons. These nuclei in turn captured neutrons, and progressively heavier nuclei were formed. The neutron content in these nuclei was controlled by β-decay between successive neutron captures. The physical conditions which are indicated for the period of element formation are inconsistent with a cosmological model of the early stages of the universe based on matter only. It appears that the early stage was probably a universe of radiation with a trace of matter present. According to this picture, the element-building process began some 200 to 300 seconds after the start of the expansion, at which time the temperature was of the order of 10^9 °K, and the density of matter was of the order of 10^{-3} g/cm^3. Because of the expansion of the universe, and because of the decay of neutrons, the production of elements must have been essentially complete in a time of the order of magnitude of the neutron decay lifetime. Preliminary calculations based on this theory successfully predict the observed relative abundance data.

498 The Occurrence of He^3 in Natural Sources of Helium by L T Aldrich and Alfred O Nier Phys Rev 74 1590-1594 (1948) Dec 1

A 60° mass spectrometer, similar to one previously described (Nier, Rev Sci Instruments 18 398 (1947)) was slightly modified for these investigations of the He^3/He^4 abundance ratio in helium extracted from the atmosphere, gas wells, and a number of minerals. The extraction and purification system is shown along with tabulated data of the values obtained for the different helium sources. Wide variations were found to occur which suggest the necessity of further investigations. Since He^3 is observed in all sources except radioactive minerals, the authors suggest the possibility of a primordial source as well as more recent sources for this isotope.

499 On the Formation of Shielded Isobars by the Nuclear Photo-Effect by J S Smart Phys Rev 74 1882 (1948) Dec 15 (Letter to the editor)

It is noted that the neutron capture theory of Gamow and Alpher (Physical Review 70, p. 572, 1946; 73, p. 803, 1948; and private communication) does not predict the existence of isobars, since, if all nuclei are formed with an excess of neutrons, the only nuclear species of mass A that can be formed is the one with the lowest Z necessary for stability. The suggestion is made that "shielded" isobars of the form Y_Z^{A+2} were formed as a result of the photo-emission of neutrons since the conditions presumed to exist during the early stages of universal expansion would favor the (γ,n) reaction. An investigation of 55 sets of even-even isobars indicated that in 41 cases the shielded isobar could have been formed by a (γ,n) reaction with a stable odd nucleus. In the 14 other cases it could have been formed by two consecutive reactions of this type. Abundance calculations qualitatively support this theory and, in addition, it is noted that the photo-effect mechanism would not

ISOTOPES (continued)

produce any shielded isobars which do not exist. An approximate calculation is made which results in a correct order of magnitude for the (γ,n) probability at a temperature consistent with Alpher's neutron capture theory.

500 On the Relative Abundance of the Elements by Ralph A Alpher and Robert C Herman Phys Rev 74 1737-1742 (1948) Dec 15

The theory of the neutron capture process for the formation of the elements has been reformulated, taking into account the radioactive decay of neutrons as well as the expansion of the universe. However, the calculations have been carried out for the case of a static universe. Satisfactory agreement between this theory and observed relative abundances has been obtained with the assumption that the density of matter was $5 \times 10^{-9} g/cm^3$ at the start of the capture process.

501 The Preparation of Radioactive Tracers by F A Paneth Quart Revs 2 93-106 (1948)

A review is presented on the subject of radioactive tracers. The subject matter is divided into four parts; I. The selection of a suitable tracer substance, II. The production of the chosen radioactive atoms, III. The analytical separation and concentration of these atoms, IV. The synthesis of the tracer substance incorporating the radioactive atom. 24 references.

ISOTOPES SEPARATION

502 Szilard-Chalmers Reaction on Antimony by Lars Melander Acta Chem Scand 2 290-291 (1948)

With phenylstibinic acid and triphenylstibine, the author tried to obtain a Szilard-Chalmers concentration of the β-active isotopes formed by slow neutron action on antimony. Phenylstibinic acid gave negative results, while triphenylstibine was suitable. As much as 50% of the activity of an irradiated triphenylstibine solution may be extracted using water containing small amounts of antimony and tartaric acid. A second extraction will take up more activity (up to 9%). Data are given for two typical experiments.

MASS SPECTROGRAPHY

503 Mass Spectrometric Examination of Rare Gas Spectra by R F Hibbs. AECU-37 (y-193) July 6 1948 9p

On the basis of this preliminary examination, it is apparent that the mass spectrometer can be used to identify impurities in rare gases. The limit of the detection of these impurities is probably of the order of 1 part in 100,000 parts of sample though this figure is subject to some variation with different ions. This is especially true for impurities such as nitrogen, oxygen and water. These materials are the most abundant background ions, and their intensities are affected by the introduction of sample gas. Recorded spectra of instrument background and samples of neon, krypton and xenon are included.

504 Construction of Glass Diaphragm Leaks for Gas Analysis With a Mass Spectrometer by Vernon H Dibeler and T Ivan Taylor Science 108 686-688 (1948) Dec 17

The authors have designed and made a number of uniform diaphragm leaks with which to perform satisfactory gas analyses with a mass spectrometer. The diaphragms are made from glass and the construction is described in detail with accompanying sketches. Calculated effective areas agreed with the experimental results.

505 Electron Gun for Mass Spectrometers by Norman D Coggeshall, Verona, and Nathan F Kerr, Pittsburgh, Pa., assignors to Gulf Research and Development Company, Pittsburgh, Pa. U S Patent No. 2,457,530 Dec 28 1948

This invention tries to overcome the disadvantages of a thermionic emission source of electrons and provides for a cathode ray oscillograph, television equipment, electron microscopes,

MASS SPECTROGRAPHY (continued)

and other devices as well as close and accurate control of the electron stream emerging from the new type of gun. The mass spectrometer has an external light source casting light through a window in an envelope containing a photo cathode, electron multiplier, and electron lens for forming a stream of electrons to ionize gaseous and gaslike materials.

506 Errors in Mass-Spectroscopic Doublet Measurements, II by Heinz Ewald Z Naturforsch 3a 114-124 (1948)

By shortening the length of the adjusted slit from 4 to 0.2 mm, the error in the measurement of distances between doublets, resulting when canal-ray tubes are used as ion sources, may be made negligible. The angle of dispersion of the ionic rays which have passed through the precision slit varies with the nature of the ions present. Thus, second-order errors will vary in magnitude for different lines. The dispersion angles observed were in general unsymmetrical, and it is estimated that they should not exceed 0.05°.

507 The Focusing in Crossed Fields of Charged Particles at Relativistic Energies by W E Millett Phys Rev 74 1058-1063 (1948) Nov 1

The motion of charged particles traveling with relativistic energies in a uniform magnetic field superimposed at right angles to the electric field of a cylindrical condenser has been investigated. Expressions for the angle at which first-order focusing of a divergent beam of particles occurs and first approximations to the line breadth as well as dispersion in velocity, momentum, and energy are given.

508 Mass Spectrometry by Robert V Langmuir, Schenectady, N. Y., assignor to Consolidated Engineering Corporation, Pasadena, Calif. U S Patent No.2.457,162 Dec 28 1948

This patent deals with the improvement of mass spectrometry involving the production of a pulsating current which can be amplified with alternating current instruments. This alternating current increases the speed of analysis due to the slowness of direct current instruments. The required pulsations may be brought about in various ways: (1) by varying the intensity of the beam of ionizing particles (such as electron), (2) by varying the velocity (or energy) of these ionizing particles (electrons), and (3) by varying the forces acting upon the ion components.

509 The Performance of a New Radio-Frequency Ion Source by P C Thonemann, J Moffatt, D Roaf and J H Sanders Proc Phys Soc 61 483-485 (1948) Nov 1 (Letter to the editor)

A radio-frequency ion source is described which gives high ion currents, a high atomic content, and ions of uniform energy. A high concentration of atomic hydrogen is maintained in a pyrex discharge tube by reducing the exposed metal surfaces to a minimum and producing a high degree of ionization by a coil round the tube excited by a 20 Mc/sec 150 watt oscillator. The discharge is self-starting provided the probe voltage is off. A tungsten wire anode is isolated from the main discharge by a constriction. An assembly diagram is shown and the theoretical contour for a homogeneous beam with the D^+ ion contour is compared with the experimental curve for given operating conditions. Tabulated data are given for the mass spectrum of a deuteron beam and for the variation in proton and deuteron percentages with pressure in the source.

510 The Production of Intense Ion Beams in a Mass Spectrometer by Rene H Bernas and Alfred O Nier Rev Sci Instruments 19 895-899 (1948) Dec

A simple 60° mass spectrometer has been built for the production of intense ion beams. Ions are produced by allowing an electron beam collimated by a transverse magnetic field to bombard the vapor issuing from a furnace. By adjusting conditions properly an arc may be struck and total ion currents of 1 to 2 ma could be obtained from the source when the accelerating voltage applied was

MASS SPECTROGRAPHY (continued)

15 Kev. The collected isotopes were completely resolved, and a total current of 0.3 ma for the several isotopes at the final collector was observed. Because of gas focusing at the operating pressure, space charge effects did not seriously affect the resolution and a resolving power of 1/100 could be obtained. In a 14-hr run 6.5 mg of separated zinc isotopes were collected. Preliminary results with magnesium, as well as other solids, indicated that many other substances could be separated without modifying the apparatus. Improvements which would permit higher yields are suggested. A photograph and apparatus diagrams are shown and data on the arc operating conditions are given in tabular form. Curves of the source output current as a function of temperature and of the ion current as a function of mass number are shown for zinc.

METALLURGY

511 A High Temperature Precision X-ray Camera - Some Measurements of the Thermal Coefficients of Expansion of Beryllium by Paul Gordon. AECD-2426 (MIT-1009) Oct 1 1948 Decl Dec 29 1948 35p Proposed for publication in J Applied Phys Document for sale by AEC

A high temperature x-ray camera has been designed and constructed by modification of the back-reflection, symmetrical-focussing type of camera. The camera, specimen and furnace are used within a vacuum chamber to avoid oxidation. The apparatus in its present form has been employed at temperatures up to 1000°C, but higher temperatures could be easily attained by making a few minor changes in the furnace materials. The lattice parameters of beryllium have been measured up to 1000°C. The derived coefficients of thermal expansion, both linear and bulk, are presented as a function of temperature. In addition, the data offers evidence that the hexagonal close packed form of beryllium which exists at room temperature is stable up to at least 1000°C.

512 Preparation and Properties of Some Gold Alloys by A U Seybolt. AECD-2434 (LADC-141) Sept 30 1943 Decl Dec 21 1948 10p Document for sale by AEC

Samples of gold and five gold alloys were prepared and tested for hardness, yield strength in compression, and density. The alloys contained approximately 5 percent and 10 percent Ni, and 10 percent each of Mn, Fe, and U. Nickel was by far the most potent addition for hardening and strengthening; a yield strength (0.2 percent offset) of about 69,000 psi was found for the alloy with 10 percent compared with 5,800 psi for pure gold. All alloys were less dense than gold, 10 percent Ni having a denstiy of 17.06, 10 percent U, 18.6. The gold-manganese and the gold-iron alloys showed some age hardening effects.

513 The Measurement of Activity Coefficients of Metal Solutions by Leslie Seigle and David Turnbull. AECU-39 (GEPM-4) Oct 1948 31p

The importance of thermodynamic data to metallurgical problems is discussed, and a brief outline of the thermodynamics of solutions is presented. Methods for determining experimentally the activities of the components of liquid and solid metallic solutions are described. These methods are: (1) measurement of the potential of electrolytic cells; (2) measurement of partial vapor pressures, and (3) studies of chemical equilibria with gas or fused salt mixtures. The principal limitations of the methods are discussed. A tabulation is given of the metallic systems for which activity data are available. 92 references.

514 Preparation of Metallic Nickel Films by Means Other Than Electro-Deposition and Vacuum Sublimation by Fred E Croxton. AECU-46 (K-323) Dec 24 1948 9p

A bibliography has been compiled as a result of a search of "Chemical Abstracts" 1916 through 1947, "The Industrial Arts Index" 1935 through 1948, and the "Engineering Index" 1946 and 1947.

METALLURGY (continued)

515 The Vapor Pressures of Inorganic Substances. I. Beryllium by Robert B Holden, Rudolph Speiser and Herrick L Johnston J Amer Chem Soc 70 3897-3899 (1948) Nov

Using both the Langmuir and the Knudsen methods, the authors determined the vapor pressure of beryllium (vacuum cast and sintered) between 1171 and 1552°K. The results of the two methods agree well and show the condensation coefficient to be unity. Tables of data and vapor pressures are presented for vacuum cast as well as sintered beryllium, and ΔH is calculated, giving a mean value of 75,560 $\pm$ 370 cal. The vapor pressure equation was calculated to be: $\log P(\text{atm.}) = 6.186 + 1.454 \times 10^{-4}T - (16{,}734 \pm 80)/T$.

MINERAL RESOURCES AND MINERALOGY

516 Atomic Materials in Italy Forecast 10 408 (1948) Sept

Geological research is reported to have led to the discovery of uranium deposits in the region of Nuoro in the northeast of Sardinia. Radioactive minerals have also been discovered near Lake Como.

517 Atomic News Forecast 10 485-486 (1948) Nov

The mineral monazite, which yields thorium, is found in the sands of the beaches along the coast of Queensland. These sands also contain zircon and rutile. The commonwealth government has set up an office at Coolangatta for buying sands containing a minimum of 10% monazite.

518 The Effect of Potassium in Prospecting for Radioactive Ores by F E Senftle Can Mining J 69 No. 11 55-57 (1948) Nov

Potash-bearing rocks very frequently give an erroneous impression to prospectors due to the hard gamma activity of potassium. It was recently demonstrated by Hess and Roll (Phys Rev 73 592-595 (1948)) that potassium content produced an ionization effect about twice that of the thorium and uranium combined. The author investigated the effect a prospector may expect due to potassium radiation. A number of deposits were chosen and analyzed for potassium by the beta counter method. The results are listed together with chemical analyses. It is seen that a reading of several times the background might be experienced on a Geiger counter, and that the counting number will depend on the concentration, thickness, and extent of the potash-bearing material.

519 Handbook of Uranium Minerals by Jack DeMent and H C Dake Portland, Oregon, Mineralogist Publishing Company (1947) 80p

This book, containing a catalog of uranium and thorium minerals, also concerns itself with their prospecting and detecting, an analysis of the world's supply, and a general explanation of the importance of uranium.

520 Rich French Uranium Find Chem Eng News 26 3782 (1948) Dec 20

Samples of ore from a mine near Entraygues in southern France indicate the presence of the richest deposit of uranium in France and, possibly, in Europe.

521 U. S. Atomic Energy Commission Announces Program to Stimulate Production of Domestic Uranium Calif J Mines and Geol 44 417-425 (1948) Oct

The United States Atomic Energy Commission announced a three-point program to stimulate the discovery and production of domestic uranium by private competitive enterprise. The major elements of the program are: 1. Government guaranteed ten-year minimum prices for domestic refined uranium, high-grade uranium ores, and mechanical concentrates. 2. A bonus of $10,000 for the discovery and production of high-grade uranium ores from new domestic deposits. 3. Government guaranteed three-year minimum prices for the low-grade carnotite- and roscoelite-type uranium-vanadium ores of the Colorado plateau area and Government operation of two vanadium-uranium plants in that area.

MINERAL RESOURCES AND MINERALOGY (continued)

522 Uranium in South Africa Ind Chemist 24 643 (1948) Oct

The presence of uranium has been detected in gold ores mined by the Witwatersrand gold mines in South Africa. Research is being done to find a method of separating uranium from ores without interfering with the present process of extracting gold. A bill has been introduced in the South African House of Parliament to control uranium ores and the production of atomic energy in any form.

NEUTRONS

523 Interaction of Neutrons with Electrons in Bismuth by L J Rainwater, I I Rabi and W W Havens Jr. AECD-2415 Dec 6 1948 Decl Dec 9 1948 1p

This document is an abstract; it is reproduced below in its entirety.

The neutron-electron interaction (non-magnetic) can be determined from the dependence on neutron wave length of the slow neutron cross section of liquid lead or bismuth. Preliminary investigations using molten lead were previously reported (Havens, Rabi and Rainwater Phys Rev 72 634 (1947)). These studies have been continued using molten bismuth which has an unusually small absorption cross section and no observed resonances. One main possible source of systematic error has been eliminated by the use of a standard filter comparison technique (described by Melkonian in a previous abstract on the free neutron-proton cross section). The neutron-electron cross section can be expressed in terms of the Born formula by specifying an equivalent interaction potential, V, acting over a volume τ. Choosing $\tau = 4/3\pi\, a^3 = 9.3 \times 10^{-38} cm^3$, where $a = 2.8 \times 10^{-13}$cm (for simplicity), the value of V was previously given (Havens, Rabi and Rainwater Phys Rev 72, 634 (1947)) as 2500 ev with considerable uncertainty. The present measurements give a somewhat larger value which is several times the experimental uncertainty.

524 A Precise Determination of the Slow Neutron Cross Section for Free Protons by E Melkonian, L J Rainwater and W W Havens Jr. AECD-2416 Dec 6 1948 Decl Dec 9 1948 1p

This document is an abstract; it is reproduced below in its entirety.

The free n-p cross section measurements (Phys Rev 73 1265 (1948)) using the Columbia Neutron Spectrometer have been considerably improved. Inconsistencies in separate measurements led to the development of a "standard filter" technique to eliminate the effect of a slight variation of detector efficiency with counting rate. These inconsistencies have now been eliminated and the result is significantly shifted. The technique used (to be described) compared the sample transmission with the geometric factor of a B_4C aperture system.

Experimental results for H_2 gas for $E > 1$ ev show a $1/E$ slope of 0.67, as predicted by Placzek, and give $\sigma_o = 20.37$ barns. Measurements using n-butane and H_2O confirm this, giving 20.34 and 20.35 respectively after multiple scattering corrections have been made. These corrections have been taken as +0.03, for the gases. However the much larger value, +0.10, used for H_2O will be discussed. The best value of the free proton cross section from these measurements is $\sigma_o = 20.36 \pm 0.10$.

525 The Scattering of Slow Neutrons by Paramagnetic Crystals by I W Ruderman, W W Haven Jr, T I Taylor and L J Rainwater. AECD-2417 Dec 6 1948 Decl Dec 9 1948 1p

This document is an abstract; it is reproduced below in its entirety.

The paramagnetic scattering of neutrons by anhydrous crystals of maganese fluoride, manganese oxide, and manganese sulfate has been studied using slow neutron transmission data obtained with the Columbia velocity spectrometer for neutron wave-lengths up to 6.2 A. The paramagnetic cross section, σ_{pm}, may be separated from the total cross section in regions where there are no interfering crystal diffraction effects. The results indicate a large paramagnetic cross section for the Mn^{++} ion in the compounds studied, in agreement with the theoretical calculations of Halpern

NEUTRONS (continued)

and Johnson (Phys Rev 51 992 (1937); 52 52 (1937); 55 898 (1939)). The observed dependence of σ_{pm} on the neutron wave-length has the predicted form. In the low energy region ($\lambda > 4A$) it was necessary to use Be and BeO filters to reduce interference from fast neutrons.

526 Slow Neutron Velocity Spectrometer Studies: Al, Cr, C, Fe, Ni by W W Havens Jr and L J Rainwater. AECD-2418 Dec 6 1948 Decl Dec 9 1948 1p

This document is an abstract; it is reproduced below in its entirety.

Aluminum shows strong resonances at 2300 ev and above 10,000 ev strong crystal interference effects in the thermal region are observed. Chromium shows a strong resonance at 4200 ev and weak dips at 12 ev and 18 ev which may be due to impurities. Below 10 ev the cross section closely follows the line $\sigma = (4.0 + 0.54\ E^{-1/2})$ (barns). The carbon cross section is constant at (4.70 ± 0.05) above 1 ev. Strong crystal effects are obtained in the thermal region with large "breaks" in the cross section at the critical wave lengths. The cross section of iron below about 15,000 ev is well represented by the relation $\sigma = (11.2 + 1.02\ E^{-1/2})$ except in the thermal region where interference "breaks" are observed at λ = 2.3, 2.8 and 4.1 A. Beyond 4.1 A the cross section drops from 19.0 to 6.5. Above 15,000 ev the Fe cross section decreases to about 5 at zero time of flight. Ni shows a resonance at 3600 ev with the cross section remaining above 16 below 1000 ev.

527 Elastic Scattering of 90 Mev Neutrons by A Bratenahl, R H Hildebrand, C E Leith and B J Moyer. AECD-2425 (UCRL-218) nd Decl Dec 9 1948 3p

This document is an abstract.

An experiment to determine the differential cross sections at various angles for elastic scattering of 90 Mev neutrons by Be, C, Al, Cu, Ag, and Pb nuclei is described and the results are tabulated. A comparison is made between measurements using two types of neutron detectors: pieces of carbon activated by the $C^{12}(n,2n)C^{11}$ reaction (20.5 Mev threshold) and a recoil proton counter (60 Mev threshold). This comparison provides a measure of the error due to detection of inelastically scattered neutrons. Elastic scattering cross sections are obtained by integration of the differential cross sections. These scattering cross sections are compared to total cross sections determined by attenuation measurements using the same detectors. Total cross sections in barns resulted as follows:

	Be	C	Al	Cu	Ag	Pb
Carbon Detector measurement		.548 ± .01	1.13 ± .03	2.09 ± .09		4.45 ± .21
Recoil counter measurement	.367 ± .028	.412 ± .028	0.994 ± .073	1.75 ± .07	2.90 ± .26	4.06 ± .23

528 Neutron-Deuteron Scattering at High Energies by Frederick deHoffmann. AECU-36 (LAMS-752) May 20 1948 69p

The value of the n-n cross section at various energies is of fundamental interest to nuclear physics because of the direct bearing on the question of nuclear forces. Unfortunately it is difficult to obtain direct experimental evidence about this cross section. The method of using two beams of neutrons can not yield results because as yet beams are not available that are intense enough for this purpose. Thus all information about the n-n cross section is limited to that obtained by indirect means.

The fundamental idea of the Berkeley work is described as follows: At high energies the n-d cross section should, in first approximation, consist only of the sum of the n-p and n-n cross sections. This is based on the assumption that at high energies the wave length of the incident neutron is short compared to the inter-nuclear distance between the nucleons in the deuteron and that the energy of the incoming neutron is very high compared to ϵ, the binding energy of the deuteron in

NEUTRONS (continued)

the ground state. In this approximation the difference between the n-d and n-p should then yield the n-n cross section. Previous experimental evidence shows a large discrepancy between the inferred n-n and the measured n-p cross section. In consequence it was thought desirable to examine just how accurate it is to consider the n-d cross section as the sum of the n-n and n-p cross section for 90 Mev neutrons. The present thesis is an attempt to estimate these correction terms. The correction terms are considered to be due to two causes, finite binding of the deuteron in the ground state and interference of the waves scattered from the two particles in the deuteron.

529 On the Interpretation of Inelastic Scattering Data by Bernard T Feld. AECU-40 (LP-105) July 29 1948 11p

So long as the incident neutron energy is less than the energy of the first excited state of the target nucleus, the only neutron-scattering process possible is elastic scattering. However, when the incident neutron energy exceeds the excitation energy of the lowest level of the target nucleus, it is possible for the target nucleus to take up this energy leaving the emergent neutron with a kinetic energy equal to the difference between the incident (less that lost to the recoil nucleus) and the excitation energies; this process is called inelastic scattering. The product nucleus, left in an excited state as a result of the inelastic-scattering process, usually gets rid of its excitation energy by the emission of one or more gamma rays. From the energies and numbers of these gamma rays it should be possible to derive considerable information concerning the level structure of the target nucleus and the relative cross sections for excitation of different levels of the target nucleus by the incident neutrons. Available experimental evidence is reviewed. The experimental data indicate that inelastic scattering can be understood in terms of a detailed level scheme of the target nucleus for low incident fast neutron energies and the statistical theory of Weisskopf at high incident neutron energies. Light nuclei ($A \sim 50$, together with lead and bismuth) show a large level spacing ($\sim$1 Mev) up to an excitation energy of 3 Mev, while the data on heavy nuclei ($A \sim 200$) are consistent with a smaller level spacing ($\sim .05$ Mev). 10 references.

530 Capture Cross-Sections for Fast Neutrons by D J Hughes, W B Spatz, N Goldstein and D Sherman. AECU-44(ANL-4223) Oct 1 1948 28p

It was the purpose of the present measurements to isolate the nascent fission neutrons of energy about one Mev and use them for measurement of absorption cross-sections. Unmoderated fission neutrons were obtained by irradiating a plate of uranium metal in a beam of slow neutrons from the thermal column of the Argonne heavy water pile. A foil placed inside heavy Cd near such a plate receives only unmoderated fission neutrons, if all slowing down materials are carefully excluded. The procedure is to activate a cadmium covered foil of the material of interest with fission neutrons while an identical bare foil is simultaneously activated with thermal (plus fission) neutrons. The two foils are then counted on a GM counter. The fast activation cross-section is obtained directly from the counting rate ratio, the known thermal cross section for the particular activity detected and the calculated ratio of fast to slow flux at the plate (which is approximately unity). A slight activation sometimes resulted from the small number of resonance neutrons present in the thermal column if the substance had a high resonance cross-section. The resonance activation could be estimated however by running a Cd-covered foil with the uranium plates removed. The resulting cross-section is an average over the fission spectrum but, because the variation of σ (n,γ) with energy is about the same for different elements near 1 Mev (approximately 1/E), the measured cross-sections can be correctly considered as capture cross-sections at 1 Mev neutron energy (as calculated from the known fission spectrum and a 1/E energy dependence). A discussion of results is reported and comparison with other measurements in the literature is made.

531 N^{17}, A Delayed Neutron Emitter by L W Alvarez. AECU-53 (UCRL-201) Nov 5 1948 19p

A 4.2 second period was found to be produced in greatest intensity by the reaction of deuterons on fluorine. Deuteron bombardment of elements beyond fluorine gave the same activity with smaller

NEUTRONS (continued)

intensities. The decay scheme has been investigated in detail. Chemical and physical evidence shows that it is N^{17}, which emits beta rays to a broad excited state of O^{17}, which then breaks up into a neutron plus O^{16}. The energy spectrum of the neutrons is determined by measuring the energies of the O^{16} recoils in a proportional counter. The neutrons have a most probable energy of 0.9 Mev, a "half width" of less than .5 Mev, and an upper limit of about 2 Mev. β-recoil coincidences are observed, as predicted by the Bohr-Wheeler theory, and the β-ray energy is measured by absorption. The beta rays in coincidence with neutrons have an upper limit of 3.7 ± 0.2 Mev. Beta rays directly to the ground state of O^{17} are not observed because of high background effects, but should have an energy of 8.7 Mev. Some evidence is presented to show that energy is conserved in the β-n transition through the broad excited state in O^{17}.

532 Angular Dependence of Coincidences Between Fission Neutrons by S DeBenedetti, J E Francis Jr, W M Preston and T W Bonner Phys Rev 74 1645-1650 (1948) Dec 1

This article is based on AECD-2153. An abstract of this document was assigned the number MDDC-1530 and appeared in Abstracts of Declassified Documents 2 16 (1948) Jan 31.

533 Delayed Neutrons by S Das Nature 162 853 (1948) Nov 27

The possibility of the emission of delayed neutrons from certain members of fission chains by an electro-disintegration or (e,n) process is discussed. The author concludes that such a process, being analogous to photo-disintegration, will result in neutron emission caused by the high energy electrons throughout the β-life. As experimental evidence, it is noted that for Kr^{87} and Xe^{137} the neutron emission follows the β-life. Recent data (Knable et al, Bull Amer Phys Soc 23 (3) 20 (1948)) on the delayed neutron emission observed during the β-decay which has been attributed to N^{17} is interpreted as resulting from N^{16} which by β-emission goes to O^{16}. The neutrons emitted are attributed to a simultaneous electro-disintegration process.

534 Fast Neutron-Proton Scattering and the Law of Interaction between Nucleons by E H S Burhop and H N Yadav Nature 162 738-739 (1948) Nov 6

Using the values of the constants of the interaction functions as determined by Hu and Massey (to be published), a systematic investigation of the dependence of the total cross-section and angular distribution in high n-p scattering on the range and shape of the assumed interaction has been made. Tabulated calculations for the range and total cross section for three types of n-p interaction (with exchange properties suggested by the symmetrical, charged and neutral meson theories) and the ratio of the differential cross section at 180° to that at 90° in the c.m. system are given for four assumed interaction shapes, i.e. the spherical well, Yukawa potential, exponential potential and the Gaussian potential. It is noted that the interaction types for the charged and neutral meson theories result in larger total cross sections than those for the symmetrical meson theory. In addition the ratio of the differential cross section at 180° to that at 90° is always greatest assuming the interaction type of the symmetrical meson theory and always less than unity for the interaction of the neutral meson theory. The Yukawa potential for the interaction associated with the symmetrical meson theory gives a value of 9.1×10^{-26} cm^2 for the total cross section which is the calculated value closest to the experimental value of $8.3 \pm 0.4 \times 10^{-26}$ obtained at Berkeley for 90 ± 13 Mev neutrons (Cook, McMillan, Peterson, and Sewell, Phys Rev 72 1264 (1947)). The data are discussed in general and it is noted that a full account of the work will be published elsewhere.

535 Interaction between Neutrons and Nuclei by V N Kondratyev Uspekhi Fiz Nauk 34 169-261 (1948) Feb (In Russian)

In the "Introduction" neutron reactions are surveyed and the conception of "cross section" is defined. Chapter I, "Theory of nuclear reactions," gives Weisskopf's deduction of dispersion formulas for cross sections of nuclear processes, based on wave-mechanical considerations, and a discussion of Weisskopf and Ewing's formula covering the cases of interaction between rapid neutrons and heavy nuclei. Chapter II, "Methods for measuring cross sections." Chapter III, "Experimental data." Survey of characteristic features of the cross sections of different elements, in

NEUTRONS (continued)

their relation to the energy of the acting neutrons. This is followed by an extensive table for all elements, giving scattering and absorption cross sections, sources of neutrons, and their energies. (93 pages of which 61 is a table of cross sections).

536 An Investigation of the Neutrons Produced in the Deuteron-Deuteron Reaction by D L Livesey and D H Wilkinson Proc Roy Soc 195A No.1040 123-134 (1948) Nov 12

Some properties of the $_1H^2 + {}_2H^2 = {}_2He + {}_0n^1$ reaction were investigated by the photographic plate technique for a bombarding deuteron energy of 920 Kev. Thick deuterium targets only were used. Measurements were taken of the neutron spectrum for various emission angles, and the angular distribution of the neutrons was investigated. The experimental data were compared with theoretical calculations. The Q of the reaction was determined to be (3.23 ± 0.02) Mev. The problems arising in the application of the technique to the precision determination of neutron energy are discussed, and the previous precision determination of the Q value by Bonner (Phys Rev 59 237 (1941)) is criticized. The present results are in good agreement with the Q value of the reaction $_1H^2 + {}_1H^2 = {}_1H^3 + {}_1H^1$ and the maximum energy of the $_1H^3$ β-spectrum. The neutron spectra are in accord with those calculated from the ballistics of the reaction and the known excitation function. The neutron angular distribution shows a marked maximum in the forward direction and a minimum at 90° to the deuteron beam.

537 The Magnetic Moments of the Neutron and Proton by Kenneth M Case Phys Rev 74 1884-1885 (1948) Dec 15 (Letter to the editor)

The magnetic moments of the neutron and proton were calculated in both the charged and symmetrical pseudoscalar theories using the pseudovector coupling. The results expressed in nuclear magnetons were: charged theory,

$$\mu_p = 1 + \frac{1}{4\pi}(g^2/4\pi\hbar C)\ \frac{C_1(\mu/M)}{(\mu/M)^2}$$

$$\mu_n = -\frac{1}{4\pi}(g^2/4\pi\hbar C)\ \frac{(C_1(\mu/M) + C_2(\mu/M))}{(\mu/M)^2}$$

and symmetrical theory,

$$\mu_p = 1 + \frac{1}{4\pi}(g^2/4\pi\hbar C)\ \frac{(C_1(\mu/M) + \frac{1}{2}C_2(\mu/M))}{(\mu/M)^2}$$

$$n = -\frac{1}{4\pi}(g^2/4\pi\hbar C)\ \frac{(C_1(\mu/M) + C_2(\mu/M))}{(\mu/M)^2}$$

where g is the coupling constant with the dimensions of charge, μ = meson mass, and M = nucleon mass. C_1 and C_2 are slowly varying functions of the mass ratio. For μ/M between zero and 0.3 these functions may change by something like 10%. For $\mu/M = 0.1$ the numerical values are $C_1 = 0.55$ and $C_2 = 1.00$.

Fitting the neutron moment to the experimental value yields values of $(g^2/4\ hC)$ between 0.2 and 0.3 -- in reasonable agreement with other determinations.

The results seem to indicate that the techniques which have succeeded so well in electrodynamics will be equally successful in obtaining sensible answers from meson theories.

538 Neutrons in the Penetrating Showers of the Cosmic Radiation by G Cocconi, V Cocconi-Tongiorgi and K Greisen Phys Rev 74 1867-1868 (1948) Dec 15

Data on the neutron component of penetrating cosmic ray showers have been taken at 3200 m above sea level. A diagram of the neutron detector system is shown; this consisted of 20 G-M counters suitably arranged about the absorber material and 12 proportional BF_3 counters embedded in a paraffin block. Tabulated data are given of the results obtained using Pb, Fe, and C (graphite)

NEUTRONS (continued)

absorbers which indicate the presence of many neutrons (of energies less than 10 Mev). From this it is concluded that probably two different processes are involved, the production of the penetrating particles being attributed to an interaction among nucleons, while the evaporation of excited nuclei may be the main process responsible for the production of the observed neutrons. The possibility that nearby nuclei are excited by the particles produced in the primary act and consequently also emit neutrons and possibly star-producing heavy-ionizing particles is suggested.

539 Probability Problems in Nuclear Chemistry by Erwin Schrödinger Proc Royal Irish Acad 51 1-8 (1945) Dec

The elementary theory of the probability of an avalanche of fissions occurring as a function of the average number of fissions induced by the first chance fission is discussed preliminary to a consideration of the absolute probability of such an occurrence under a particular set of conditions. An expression is obtained for the total probability that the original fission will come to a stop; the probability "η" of a neutron's being removed by temporary or permanent nucleus capture is considered a constant. From this expression the condition for certain stopping of a given reaction is determined. The latter is further discussed and a correction is made for the difference between "stopping eventually" and "stopping after any number of cascades, however great."

The local variation in η at different points in the reacting body, which was neglected in the aforementioned calculations, is discussed. A suitable mean value of η for use in these calculations is suggested by defining η in terms of the general probability of a fission's taking place at the point "r"; the latter is assumed to be given by the first eigenfunction of an appropriate integral equation. The suggested method of obtaining an appropriate mean value of η is confirmed mathematically and the necessary conditions are obtained for the cases: a) no initial fission is efficient in producing the reaction, and b) any initial fission, wherever it occurs, has a non-vanishing chance of producing the reaction (i.e., an avalanche of fissions).

540 The "Thick-Film Chamber" Method for the Measurement of Fast Neutron Flux by K W Allen and D H Wilkinson Proc Cambridge Phil Soc 44 581-587 (1948) Oct

The absolute fast neutron flux was determined for neutrons obtained from the reaction H^2 (d,n) He^3 by obtaining ionization chamber measurements of the energies of the recoil protons produced. A thick target of phosphoric acid was bombarded with 930 Kev deuterons since, for a thick layer of hydrogen-rich material whose thickness exceeds the range of the most energetic recoil protons, only the area, stopping power and hydrogen content of the layer material are necessary for the determination of the number of hydrogen atoms in the scattering medium effective for the production of detectable recoils. The advantages of the method and the theory, as outlined by Feather (British Atomic Energy Project Report, 1944) are treated preliminary to a discussion of the experimental results obtained. The considerations which guided the investigators in the design of the ionization chamber used are also discussed. The brass ionization chamber used was 10 cm in diameter and 10 cm deep. A 40-micron tungsten wire running perpendicular to the chamber axis about 5 cm from the detachable base-plate, in the center of which a 2.65 cm diameter, 1 mm thick polythene film was fitted, served as the collecting electrode. The angular distribution of the neutron flux obtained was determined, with particularly careful measurements being made at 120°, since a comparison of fast neutron flux measurements which have been made using various methods at the Cavendish Laboratory has been made for this angle. Measurements made with a gas amplification of 5 were compared with measurements made without amplification, to check the linearity of the chamber and recording system. The bias curves obtained show good agreement with the theoretical curves. The relative flux is also shown as a function of the angle.

NUCLEAR PHYSICS - METHODS OF MEASURING

541 Review of Work on D. C. Amplifiers by Jacob S Brown. AECU-45 (ANL-4217) Oct 2 1948 11p

Diagrams and discussions are presented of degenerative circuits giving reading speed and low drift. Use of tetrode electrometer tubes (CK571AK) is used to reduce criticalness of adjustment in the Zeuto alpha contamination instrument. Circuits are suggested for improving the performance of earlier Zeuto and Betty Snoop instruments.

542 A Method of Preparing Anthracene Crystals Suitable for Scintillation Counters by J C Alley. AECU-49 (MRL-JCA-498) Oct 11 1948 7p

The process in use consists of two steps: purification of the anthracene, and formation of the crystals. Anthracene is placed in a chamber above a sintered glass filter with the alcohol-benzene mixture below. When heated, the vapors will bypass the filter, condense and dissolve the anthracene, bringing it through the filter and into the lower chamber. After the anthracene has been dissolved from the upper chamber, and recrystallized in the lower, it is cooled to room temperature, filtered, and washed with absolute alcohol. After purification, the anthracene is placed in a flask made from pyrex tubing. To form the crystal, the anthracene in the flask is melted and then slowly cooled from the bottom toward the top. To effect directional cooling, a cylindrical electric combustion furnace is placed on end and insulated so that cooling will tend to start from the bottom, Two variable voltage transformers are connected in series with the furnace, one of which is used to bring the furnace up to the melting point of anthracene (217°C). The full range of the other transformer is then used to slowly reduce the power supply. Because there is a temperature gradient through the anthracene, the temperature measured at one point in the furnace during crystal formation will go through a range which will depend upon the gradient in the system and depth of crystal being formed. The crystal is taken out of the furnace when it reaches room temperature and removed from the flask by carefully breaking away the glass. It can then be cut or sawed, and polished with a soft rag and benzene.

543 Analysis of Spurious Counts in Geiger Counters by J L Putman Proc Phys Soc 61 312-319 (1948) Oct 1

A method by which the intervals between successive pulses may be divided into size classes is described and applied to the study of Geiger counter pulses for argon-alcohol counters. By examining the deviation of the pulse interval distribution from random laws, the number and time distribution of spurious counts is deduced for various potentials applied to the counter. It is found that almost all the spurious counts occur during the recovery period of the counter. They may be eliminated by the use of an external quenching circuit which applies an artificial dead time of the order of 400 microseconds to the counter. The pulse interval analyser circuit is shown along with wave forms obtained for the anodes and grids of the tubes used. The number of intervals per minute is shown as a function of interval length. Curves are also given showing the effects of a quenching circuit on the counter and the probability of a spurious count as a function of the interval for higher orders.

544 Beta- and Gamma-Ray Spectroscopy--I by Gerald J Hine Nucleonics 3 No.6 32-42 (1948) Dec

The various methods and instruments used to investigate energies and intensities of β-rays emitted by radioisotopes are reviewed. Fermi's theory of β-decay is summarized and the β-energy spectrum shape is discussed with reference to the maximum β-ray energy, and the charge and half-life of the disintegrating nucleus.

545 Electron Bombardment Conductivity in Diamond by Kenneth G McKay Phys Rev 74 1606-1621 (1948) Dec 1

A study has been made of electron bombardment conductivity in diamond using primary electrons of energies up to 14,000 ev. An alternating field method is used which reduces or eliminates

NUCLEAR PHYSICS - METHODS OF MEASURING (continued)

the effects of internal space charge fields. Data on internal yields as a function of crystal field are given for both electron and positive hole carriers. Internal yields as high as 600 have been attained. The experimental curves are fitted to a theoretical curve for the space charge free crystal from which are derived reasonable values for the number of electrons produced in the conduction band per incident primary electron, the probable life time of the conduction electrons and the crystal trap density. Experiments are described which lead to a hypothesis of space charge neutralization. A possible cause of the current fluctuations observed at high crystal fields is discussed.

546 The Electron Multiplier as a Counter for 10-Kev Protons by J M Robson Rev Sci Instruments 19 865-871 (1948) Dec

Electron multipliers similar to the type described by J. S. Allen (Rev Sci Instruments 18 739 (1947)) are being used as counters for low energy protons. Multipliers with electrodes made from soft beryllium copper have been used to count protons in the energy range 5 Kev to 10 Kev with an efficiency between 80% and 100%. Efficiencies of about 100% have been obtained with a radioactive α-source and of about 0.2% with a RdTh gamma-source. Apparatus and circuit diagrams, tabulated data and curves are shown.

547 The Elementary Process of Light Stimulation in Luminous Substances by α-Particles, Fast Electrons, and γ-Quanta, II by Immanuel Broser and Hartmut Kallmann Z Naturforsch 2a 642-50 (1947)

Using α-particles, fast electrons, and γ-rays, the relative light yields of the following substances were investigated: ZnS, $CaWO_4$, Zn_2SiO_4, and naphthalene. The best yield using α-particles was obtained for ZnS; napththalene gave the best results for fast electrons and γ-rays. Quantitative results were obtained for the light action of single electrons and α-particles as well as for single γ-quanta. The duration and intensity of the light impulses were observed on an oscillograph which was connected to the secondary-electron multiplier photocell.

548 The Elementary Process of Light Stimulation of Luminous Substances. III. The Stimulation of Naphthalene (Further Experiments with the Light Meter) by Immanual Broser, Lieselott Herforth, Hartmut Kallmann and Ursula Maria Martius Z Naturforsch 3a 6-15 (1948)

Yield curves obtained for the light stimulation of naphthalene by fast electrons, α-particles, γ-rays, high-energy particles, and hard and soft X-rays were compared with those previously obtained for ZnS. Using hard X-rays and fast electrons yields of 10% were obtained as compared with the 2% yields obtained for soft X-rays and α-particles. It was found that the light meter is about four times as sensitive as the Geiger-Müller counter for determining the radiation per unit surface.

549 A High-Pressure Hydrogen-filled Ionization Chamber by G H Stafford Nature 162 771-772 (1948) Nov 13

A glass ionization chamber with an axial-wire collecting electrode and an Aquadag outer coating which served as the high voltage electrode was filled with pure hydrogen at a rate of one atmosphere per hour until a pressure of 88 atmospheres was reached. The size of recoil proton pulses produced by neutron irradiation was found to decrease with increasing pressure. At 88 atmospheres the pulse size had decreased to 0.18 times the value expected for complete electron collection. All pulses were still proportional to the initial ionization since the expected values were obtained when the chamber was irradiated with neutrons from several known (d,n) reactions. The curves of the counting-rate as a function of discriminator bias thus obtained are shown. The author concludes that pulse size decrease with increasing pressures must be attributed to preferential or initial recombination and notes that the effect is larger than might be expected. It is suggested that a chamber of the type used could be applied to measurements of neutron spectra up to about 13 Mev; the chamber has a high efficiency, and at 90 atmospheres it will detect 17% of 2.2 Mev incident neutrons. Future studies using deuterium to investigate the nuclear photo-effect are planned.

NUCLEAR PHYSICS - METHODS OF MEASURING (continued)

550 Investigations Using a Permanent-Magnet Double β-Ray Spectrograph with Coincidence Counting—I. Experiments with Thorium Active Deposit by N Feather, J Kyles and R W Pringle Proc Phys Soc 61 466-478 (1948) Nov 1

A detailed description is given of a semicircular focusing β-particle spectrograph in which a thin source is centrally placed and sheaves of oppositely moving electrons are investigated using two thin-windowed Geiger counters. These counters can be used in a coincidence arrangement, and each is capable of movement so as to accept electrons which have been focused with any radius of curvature between 2.5 cm and 6 cm.

The arrangement was tested using sources of thorium active deposit. During this work the (coincidence) β-particle spectrum for the ThB.C transition leading to the 238 Kev state of ThC was obtained separately for the first time and its end-point determined as 355 Kev. A feeble higher-energy β-component due to ThB was also detected and the end-point estimated at 589 Kev. Redeterminations of the end-points of the β-particle spectra of ThC and ThC″ (by β-γ coincidences) gave values of 2.256 Mev and 1.805 Mev, respectively. The intensity of the F-line of ThB was found to be 0.288 photoelectrons per disintegration.

551 A Microwave Gas Discharge Counter for the Detection of Ionizing Radiation by Sanborn C Brown and John J McCarthy Rev Sci Instruments 19 851-860 (1948) Dec

This article is based upon MIT Research Laboratory of Electronics Technical Report No. 75. An abstract of this document appeared in Nuclear Science Abstracts as Abstract No. I-1868.

552 A Mobile Geiger-Müller Tube Counting System and Some of its Medical Applications by R C Turner and W K Sinclair Brit J of Radiology 21 632-637 (1948) Dec

The design and operation of a mobile counting system incorporating a Geiger counter are described. The instrument reads directly all counting rates up to 1000 periodic impulses per second, and correction graphs are drawn for the losses sustained when random impulses are counted. The instrument is calibrated in terms of tolerance dose-rate (T.D.R.) for the γ-rays of radium and for 200 kv X-rays. For radium γ-rays, full scale deflection corresponds to about 1 T.D.R., while for X-rays it is only about 0.4 T.D.R.

Results of stray radiation measurements carried out in the teleradium treatment room (containing 1 gm and 10 gm teleradium units), and the floors beneath it, and also in the X-ray Therapy and Diagnostic Departments, are presented. A brief description of the use of the instrument in measuring activities in various parts of a patient's body after the administration of radio-iodine is also given. Instruments of similar design may be widely used in the future for work of this nature. 9 figures.

553 A New Method of Determining X-Ray Intensities by N C Baenziger J Chem Phys 16 1175-1176 (1948) Dec (Letter to the editor)

This article is based upon AECD-2333. An abstract of this document has been listed in Nuclear Science Abstracts as Abstract No. I-1515.

554 Notes on High Pressure Cloud-Chamber Operation by J S Laughlin Rev of Sci Instruments 19 918-919 (1948) Dec

A cloud chamber has been rebuilt and made more compact for studies, at pressures up through 100 atmospheres, of the angular distribution of high-energy scattering and disintegration processes; in such studies a magnetic field is not required. A diagram of the chamber which has a 4-1/2 inch active depth is shown. The vapor mixture used consisted of 60% isopropyl alcohol and 40% water. In operation for electron tracks the chamber was satisfactory up to the maximum pressure at which it was used, i.e., 40 atmospheres. A curve of the expansion ratio necessary to obtain good electron tracks as a function of pressure is shown; the data indicate a rapid decrease in expansion ratio with increasing pressure. The experimental curve mentioned is in good agreement with the theoretical curve calculated

NUCLEAR PHYSICS - METHODS OF MEASURING (continued)

from the expression derived by Johnson (Physical Review 72 86 (1947)) from a relation formulated by Kelvin. It is noted that a more rapid decrease in expansion ratio than that predicted may occur at higher pressures because of an effect due to surface tension.

555 Nuclear Research Emulsion Techniques by Kenneth R Eldridge. Office of Naval Research London Branch Technical Report OANAR-29-48 Oct 1 1948 21p (NP-500)

The photographic method has a number of advantages for some types of cosmic ray and nuclear reaction experiments. A number of problems are presented to the users of emulsions suitable for nuclear research purposes. The material must be suitably sensitive for its purpose and must have sufficient thickness and area in which to record the particles. The processing of the thick emulsions must be carried out under conditions favorable to recording the particular tracks desired. Facilities must be provided for the convenient examination of the results. An account is given of the operational methods for such work as have been developed at the University of Bristol. Sections are headed photographic plates for nuclear research; processing; and examination of the plates.

556 Personnel Dosimeters-Coloration of Crystals by X-Ray and Nuclear Radiation - Report by Optics Division by I Karle and H Friedman. Naval Research Laboratory June 4 1947 6p (NP-513)

The phenomenon of the coloration of crystals and glasses upon exposure to radiation suggests the possibility of making a simple radiation dosimeter. An instrument made from a readily available material requiring no processing and capable of measuring dosage merely by a color comparison with a standard would be practical for field purposes. Additional requirements are that the intensity of the color should increase roughly in proportion to dosage, the color should be stable under atmospheric conditions or follow a well defined law, and that different samples of the material should behave identically. A preliminary study has been made of sodium chloride and lithium fluoride crystals which appear to fulfil most of the essential requirements.

557 Pipette-type Geiger Counter for Small Quantities of Biological Fluids by D M Maurice J Phys 107 26p (1948) Sept 30 (in section of Proc Physiolog Soc (1948) Mar 20)

This counter was designed in connection with investigations of the penetration of hard β-ray-emitting tracers into the intra-ocular fluids of the cat, and had to meet the following requirements: (1) use with small liquid samples of 0.5-1 ml.; (2) good reproducibility in the positioning of the sample with respect to the counter; (3) recovery of the sample unchanged, for further study. It consists of a conventional cylindrical glass-walled counter, with a thin central window round which is sealed a glass cylinder, forming an annular space about 1 cm wide and 0.5 mm deep. Capillary tubes are fixed in the top and bottom so that the space may be filled with the sample by suction; just under 0.5 ml is necessary. No trouble has been experienced with air locks or bubbles if ordinary care was taken in filling. On blowing the sample out, just over three-quarters are recovered. A fairly constant fraction remains behind, and use may be made of this property in order to avoid cleaning and drying the counter between samples if only about 5% accuracy is aimed at. The residue of the old sample may be allowed to contaminate the new and an appropriate correction made, or, alternatively, the counter may be washed out with water, the diluent effect being equal on all samples. If no contamination is permitted, the counter can be emptied, cleaned, and refilled within 3 min.

558 Reduction of Dead Times in Geiger-Müller Counters by B Collinge Nature 162 853-854 (1948) Nov 27

The possibility that the major part of the reduction in dead time achieved by switching the central wire negative for a few microseconds after each discharge of a Geiger-Müller counter is not due to positive ion collection but rather to the localization of the ion sheath has been investigated. A circuit was used to reduce the wire potential to within 20- 30 volts of that of the cathode for about 1

NUCLEAR PHYSICS - METHODS OF MEASURING (continued)

microsecond after each count. Dead times of 3-4 microseconds have been obtained for the counter as a whole. Further data confirming the fact that the dead time may be reduced without ion collection resulting from reversal of the electrode potentials are shown. It is also noted that reduction rather than reversal of voltage has the advantage of a lower spurious count rate. The possibility that the pulses from a photo-multiplier used to detect the light produced during the formation of the ion sheath might find applications where fast time rises are required is being investigated.

559 A Simple Arrangement of High Resolving Power for the Detection of Coincidences or Anticoincidences by E F Pócza and P S Faragó J Sci Instruments 25 399 (1948) Nov (Letter to the editor)

The arrangement described consists of commercially available apparatus, and its resolving power as a coincidence detector is higher than that of the usual devices used with Geiger-Müller tubes. In the arrangement the cathode-ray tube screen is covered by an opaque shield having a slit the width of the spot and inclined at 45° to the deflector plates, and arranged so that the undeflected spot is covered. A multiplier photocell is placed in front of the slit. The illumination from the spot moving along the slit, deflected by coincident pulses, produces a pulse in the photocell which may be used to operate a recorder. The use of the same arrangement for detecting anticoincidences is described.

560 Some Properties of BF_3 in Ionization Chambers by John A Bistline Jr Rev of Sci Instruments 19 842-846 (1948) Dec

Measurements of the collection of electrons produced by α-particle ionization pulses in BF_3 are described. A comparison of pulse heights showed that 1.33 as much energy is required to produce an ion pair in BF_3 as in argon. The mean drift distance of an electron before capture in BF_3 at 76 cm of Hg varies from 1.25 cm at an E/P of 5 (volts/cm/cm of Hg) to 7.25 cm at an E/P of 20. The drift velocity is observed and varies from 0.5×10^6 cm/sec to 2.5×10^6 cm/sec over the range of E/P used. The method of preparation of pure BF_3 is described. Apparatus diagrams are shown and curves of the BF_3 pulse height as a function of voltage for BF_3 pressures in the 25-72.2 cm of Hg range are given. Curves of the drift distance and drift velocity as functions of E/P are also included.

561 Starting Potential of the Geiger-Mueller Counter Discharge by P B Weisz Phys Rev 74 1807-1812 (1948) Dec 15

The starting voltage for the pulse-equalizing Geiger-Mueller tube discharge has been measured for argon-hydrocarbons and helium-hydrocarbons mixtures. The results are discussed in the light of the known ionization potentials of the homologous series of normal hydrocarbons and the energy levels of the phenomena which contribute directly by ionization or indirectly by metastable intermediates to the production of the ions in the initial process.

562 A Study of Small Ether-Argon Geiger-Müller Counters by C V Robinson and R E Peterson Rev of Sci Instruments 19 911-914 (1948) Dec

Several ether-argon mixtures were tried in counters with cathodes ranging in diameter from 0.268" to 0.038" and with wires ranging in diameter from 2.3 mils to 0.5 mils. The results suggest an optimum relationship between cathode diameter, wire size, and mixture. Good characteristics were obtained with cathodes as small as 0.067" in diameter. Small probing counters designed on the basis of this relationship are described. Counting characteristics and construction details are shown.

563 Use of an Electron Diffraction Camera as an Ultraoscilloscope, and Suggested Application to Contact Erosion by J J Lander J Applied Phys 19 1128-1129 (1948) Dec

An oscilloscope with a time resolution of 0.001 μsec, obtained by adaptation of an electron diffraction camera, is described. A preliminary account is given of the use of this oscilloscope in a study of the "short arc" which occurs on opening mechanical contacts under certain conditions.

NUCLEAR PROPERTIES

564 Deuteron and Triton Methods by William Rarita Phys Rev 74 1799-1801 (1948) Dec 15

Some methods of accurately calculating the depths of differently shaped potentials of the deuteron for non-central forces are reported. For a square well, the radial S and D wave functions u and w outside the well are known. Inside the range of interaction a general expansion in terms of modes is assumed and the modes for u and w are taken as Bessel functions of order one-half and five-halves, respectively. The wave-lengths of these modes are determined by requiring the continuity of the logarithmic derivative. Using the variational principle for one mode and then two such modes, values of 95% and 99% of the full binding energy are obtained. With an exponential multiplied by a power series in the interparticle distance as the modes, the joining condition was modified so as to require continuity only at the potential edge. Since the results thus obtained for the square well were excellent, the method was extended to the exponential and meson potentials. The accurate depths for these potentials were calculated with these modes as initial trial wave function for the iteration-variational method developed by Feshbach and Schwinger (Unpublished communication). The relaxed continuity procedure was successfully applied both without and with tensor forces to the triton problem.

565 The Magnetic Moment of Boron^{11} by John R. Zimmerman and Dudley Williams Phys Rev 74 1885 (1948) Dec 15 (Letter to the editor)

The super-regenerative oscillator method (Physical Review 73 94 (1948)) has been improved and applied to the determination of the nuclear gyromagnetic ratio of B^{11} (in $Na_2B_2O_4$) to Na^{23}, taking the latter to be 2.217 ± 0.002 nuclear magnetons and its spin as 3/2. The ratio was determined to be 1.800 ± 0.005. If a spin I = 3/2 is assumed for B^{11}, a value of 2.700 ± 0.008 nuclear magnetons is obtained for the nuclear moment of B^{11}. This is slightly higher than the molecular beam value (Millman, Kusch, and Rabi, Phys Rev 56 165 (1939)). The precision of this method is now believed to be comparable with the bridge method of Purcell and Pound (Phys Rev 69 37 (1946)) and the nuclear induction method of Bloch (Phys Rev 69 127 (1946)). Further measurements on other compounds containing B^{11} are planned.

566 The Nuclear Spin B^{10} and Spin-Orbit Coupling in Li^7 by David R Inglis Phys Rev 74 1876-1877 (1948) Dec 15 (Letter to the editor)

In attempting to explain the large value recently measured (Gordy, Ring, and Burg, Phys Rev 74 1191(1948); see also Goldhaber, Phys Rev 74 1194 (1948); Millman, Kusch, and Rabi, Phys Rev 56 165 (1939)) for the nuclear spin of B^{10}, i.e., I = 3, instead of 1 as expected, the author notes the extreme preference for the short-range alpha transitions in the B^{10} (n,α) Li^7 transition. The thermal neutrons enter in an s state, giving rise to states of the compound nucleus having $I_r = 5/2$ or 7/2. The energies of the long-range and short-range disintegrations are only about 2.8 Mev and 2.3 Mev, requiring barrier penetration and strongly favoring small angular momenta of the alpha. It is assumed that the parity of B^{10} is even and that the low multiplets of Li^7 are odd, as in the simple models. Then the states of the compound nucleus are even, almost all the outgoing alphas have one unit of angular momentum, and Li^7 states as low as I = 3/2 can be reached if $I_r = 5/2$, or as low as 5/2 if $I_r = 7/2$. The strong preference for the transition to the excited state seems to favor the possibility that the excited state is an unresolved $^2F_{7/2,5/2}$ and that the compound state which is most influential at thermal energy has $I_r = 7/2$.

567 On the Ground State of the Deuteron by Francis Low Phys Rev 74 1885-1886 (1948) Dec 15 (Letter to the editor)

The author notes that the convenient formula for the estimation of the depth-range relation of various potentials in the theory of the deuteron, i.e.,

$$-\int_0^b V(r)rdr \cong \hbar^2/M,$$

NUCLEAR PROPERTIES (continued)

where b is the range of the neutron-proton force, V(r) is the potential energy, M the proton or neutron mass, and $\hbar^2/M$ is a lower bound to the integral, can be replaced by the exact equation

$$-\int_0^\infty V(r)u(r)\sinh\alpha r = \alpha\hbar^2/M.$$

In the last equation the reciprocal deuteron radius is $\alpha = (-ME/\hbar^2)^{\frac{1}{2}}$, and $u = \psi/r$, ψ being the wave function for the ground state of the deuteron, so normalized that

$$\lim_{r\to\infty} \frac{u(r)}{e^{-\alpha r}} = 1.$$

A proof is given which is credited to Dr. Conrad Longmire.

NUCLEAR TRANSFORMATION

568 Production of Radioactive Gases by Deuteron Bombardment of Gaseous Targets by H Brown and V Perez-Mendez. AECD-2422 Dec 6 1948 Decl Dec 9 1948

This document is an abstract; it is reproduced below in its entirety.

For the investigation of the beta-decay of short half-lives (less than 2 min), a probe through which gases may be circulated has been constructed for use with the 36-in cyclotron. The gases were bombarded through a thin window in the probe, using modulated beams of average intensity up to 15μa. These gases were then pumped to a disintegration chamber, which was isolated by stopcocks for the purpose of taking half-life data and measuring the concentrations of the activities.

Some of the reactions used with the corresponding measured half-lives are: N^{14} (d,n) O^{15}, 118 ± 1 sec; O^{16} (d,n)F^{17}, 66 ± 1 sec; Ne^{22} (d,p) Ne^{23}, 40 ± 1 sec. The concentrations of active nuclei obtained agree roughly with those to be expected from (d,n) and (d,p) reactions at this energy (8 Mev) in this region of mass number. They correspond to cross sections of about 2×10^{-25} cm^2. Additional experiments are in progress and will be reported.

569 Seminar Notes on High Energy Nuclear Reactions by Dr. I. Perlman by Irene Herndon. AECU-41 (ADL-51) Nov 5 1948 14p

Lecture notes explaining the basic principles and mechanisms of high energy nuclear reactions are presented.

570 Conference on the Chemical Effects of Nuclear Transformations (Hot Atom Chemistry); August 19-20, 1948. AECU-50 (BNL-C-7) nd 85p

At this conference the following papers were presented: Current Work in Hot Atom Chemistry at the University of Wisconsin, by G. Levey, R. Milham, W. Rice, and J. E. Willard; Some Considerations on Retention in the Liquid Phase, by J. M. Miller, and R. W. Dodson, Chemical Consequences of the (n, γ) Process for Gaseous Bromides, by R. R. Williams, and W. H. Hamill; The Hot Atom Chemistry of the Propyl Bromides, by L. Friedman and W. F. Libby; Beta Decay of Ce^{144} as the Acetylacetonate to Pr^{144}, by R. R. Edwards, and C. D. Coryell; Effects of Beta Transformations in the Gas Phase, by R. R. Edwards an C. D. Coryell; The Oxidation States of Chromium Arising From Positron Decay of Manganese, by W. H. Burgus; The Extent of Internal Conversion in Br^{80}, by W. H. Hamill, R. R. Williams, and J. A. Young; and Recoil Bromine Atoms in Neutron Capture by Gaseous Ethyl Bromine, by S. Wexler and T. H. Davies.

571 Argon and Neon (pn) Thresholds by H T Richards and R V Smith Phys Rev 74 1870-1871 (1948) Dec 15 (Letter to the editor)

Using the Wisconsin electrostatic generator, data has been taken on the A^{40} (pn) K^{40} reaction threshold using a BF_3 counter surrounded by paraffin as a neutron detector. The neutron yield curve thus obtained is shown. The nuetron yield for proton energies below 2.4 Mev was too low for an accurate determination although from mass values the Q of the reaction has been calculated at -1.1 ± 1.1

NUCLEAR TRANSFORMATION (continued)

Mev (in Elementary Nuclear Theory, by H. A. Bethe, New York, John Wiley and Sons, Inc., 1947, p. 126). However, at 2.4 Mev a sharp rise in the neutron yield was observed. It is suggested that either the mass values are in error, or more likely, that the large difference in angular momenta between the two nuclei makes the reaction very highly forbidden near the threshold. If that latter is true, the sharp rise at 2.4 Mev might indicate the formation of K^{40} in an excited state of lower angular momentum. Using neon gas in a quick search for a similar pn threshold, no neutrons were detected for proton energies up to 3.35 Mev. These results are consistent with the beta-gamma-cascade decay scheme for Na^{22} if the mass of the latter is taken as 22.0152 m.u. when Ne^{22} is taken as 21.99844. This further indicates the error in the Q of -2.1 Mev predicted using Bethe's mass values.

572 Evidence for a p,d Reaction in Carbon by Wolfgang K. H. Panofsky and Robert Phillips Phys Rev 74 1732-1733 (1948) Dec 1 (Letter to the editor)

Excitation curves of the $C^{12}(p,pn)C^{11}$ reaction were obtained in the region from threshold to 32 Mev using the Berkeley linear accelerator. Polystyrene (C_nH_n) foil stacks were bombarded, 10 mil (25 mg/cm) foils being used in the 21-32 Mev range and commercial 2.5 and 5 mil foils being used in the 16-21 Mev range. The G-M counter data curve for positron emission is shown. Absolute cross sections were obtained by collecting the protons in a Faraday cup after vacuum bombardment at 32 Mev; the value thus obtained was $(0.075 \pm 0.02) \times 10^{-24} cm^2$. From the data, the threshold for the reaction is estimated as 18.5 ± 0.3 Mev; calculations based on earlier data give a value of 20.2 Mev of the threshold. It is concluded that the process is likely to take place by a direct interaction, e.g., by direct ejection of a deuteron and subsequent decay of N^{12} with emission of a proton.

573 Observations Associated with the Reaction B^{11} (p,d) by Emmett L Hudspeth and Charles P Swann Phys Rev 74 1722 (1948) Dec 1 (Letter to the editor)

Data have been taken on the $B^{11}(d,p)$ reaction in which a radioactive isotope is formed which decays with the emission of β-rays of 0.02 Mev maximum energy (Bayley and Crane, Phys Rev 52 604 (1937)) with a half-life of 0.02 sec. (Becker and Gaerttner, Phys Rev 56 854 (1939)). By varying the bombarding voltage from 250 to 1800 kv and using coincidence counters for detection, the yield of β-rays as a function of bombarding voltage was observed: it rose rapidly up to 0.6 Mev, after which the rate of change was smaller, becoming negligible at 1.6 to 1.8 Mev. No resonances of appreciable intensity were observed. From the shape of the excitation curve at the lowest voltages, the best fit, assuming the Gamow penetration formula, was for a Q of +0.1 Mev. Scattering data on the protons obtained using an aluminum foil onto which a thin boron film had been evaporated gave a Q of 0.15 Mev, confirming the previous calculation. Other calculations indicate that it is likely that the C^{12} is left in an excited state of about 2.5 Mev. Some evidence for β-γ coincidence which would substantiate this has been obtained.

574 On the Chemistry of Element 43 (Uber die Chemie des Elementes 43) by E Jacobi Helv Chim Acta 31 2118-2123 (1948) (In German)

The author has definitely established the fact that, upon irradiating molybdenum with protons (7 Mev), only the element 43 is created; he also gives a method of procedure permitting the enrichment of element 43 without carrier. The time dependence of adsorption of the element 43 on Re_2S_7 and CuS has been investigated, and the optimum HCl concentration found to be 2.5-3 cc of concentrated HCl in 50 cc solution for a 15 minute adsorption on CuS. A method has been developed permitting separation of element 43 in 40 minutes from larger quantities of molybdenum, with only 0.3-2.0 mg carrier.

PARTICLE ACCELERATORS

575 Cyclotron Magnet and Oscillator Design by E Creutz, M Foss, G Hinman and E williams. Carnegie Institute of Technology (Office of Naval Research Contract) June 14 1947 23p (NP-504)

Studies with a 9-inch model magnet were completed. For fields near 18,000 gauss, the pole length should probably not exceed two gap lengths. The spiral sheet coil appeared to be very satisfactory. Use of some Hiperco in the poles extended the useful radius. A 2-inch model magnet to study effects of pole shape has been constructed. The 9-inch model is being modified to an approximate "final" design. Theoretical analysis of the magnetic field gives an excellent check with measurements at very low field and indicate the optimum that can be approached by using higher permeability materials.

576 Data on Birmingham Proton Synchrotron. British Report M-4272 Nov 12 1948 2p

Performance and design specifications are listed.

577 Glasgow Synchrotrons Forecast 10 408 (1948) Sept

A 300 million-volt, 150-ton synchrotron is being constructed for use in fundamental research in nuclear physics at the University of Glasgow, where a special building is being erected to house it.

578 High Frequency Proton Source by Robert N Hall Rev Sci Instruments 19 905-910 (1948) Dec

A proton source employing a 450-mc/sec. electrodeless discharge in the presence of a magnetic field is described. Ion currents of 400 μa, consisting of over 60% protons, are normally obtained, corresponding to a current density due to focused and analyzed protons of 0.03 amp./cm^2 at the 1-mm exit hole. The source requires a hydrogen flow of 30 cc/hr., most of which is prevented from entering the accelerating column by the use of a differential pumping arrangement. The ions diffuse out through the exit hole and are accelerated without the use of a probe, resulting in a well focused, monoenergetic beam accompanied by relatively few stray ions. The experimental results were obtained on a 120-kv accelerator designed to simulate the initial sections of a typical constant voltage accelerator. Construction diagrams and operating data are given.

579 High Voltage Pulser for 184-Inch Cyclotron Electric Deflector by Q A Kerns, W R Baker, R F Edwards and G M Farly Rev Sci Instruments 19 899-904 (1948) Dec

This paper describes a high voltage pulse generator developed to deflect the beam of the 184-inch cyclotron at Berkeley. The apparatus develops a deflecting potential of 200 kv that rises from 10% to 90% of peak value in 0.1 microsecond. The unit employs two similar 100-kv water-cooled pulse transformers connected symmetrically about ground to the electric deflector bars. Water-cooled General Electric pulse capacitors are discharged through the two turn primary windings of the pulse transformers by triggering a battery of 16 paralleled Kuthe 5C22 hydrogen thyratrons. Output voltages are developed across the 17-turn secondary winding of the pulse transformer; the transformer is mounted in an oil-filled Lucite case that provides both insulation and compact design. Photographs and diagrams are shown.

580 The Machine Giants of Nuclear Physics (Les Appareils Géants de la Physique Nucléaire) Atomes 3 337-344 (1948) Oct (In French)

A non-technical and brief summary of the various types of particle accelerators used in nuclear physics investigations is given. Relevant characteristics of the principal projectile-particles used are given in tabular form. A table of mass as a function of energy for the various particles is also included. The different types of accelerators are compared as to construction (with diagrams), principle of operation, type of magnetic field, accelerating force, energies obtained, and the particles which may be used as projectiles. Several photographs are also shown.

PARTICLE ACCELERATORS (continued)

581 Production of Forgings for Carnegie Tech Cyclotron by O H Baker Ind Heating 15 1654-1662 and 1844, (1948) Oct

The author describes the design, construction, and method of production of a forged steel magnet, weighing 1465 tons, and having 145-inch pole pieces. This magnet will be used in a new synchro-cyclotron, which is expected to accelerate protons to energies of over 400 million electron-volts.

582 A 600 Kv Ion Accelerator by J V Jelley and E B Paul Can Research 26F 419-425 (1948) Oct

The 600 kv ion accelerator which has been developed at the Ottawa Laboratory of the National Research Council is described. The construction and operation of the equipment are discussed in detail, and sketches and photographs are shown along with a circuit diagram of the pulse-rate integrating meter. Performance data are given for proton and deuteron bombardments of several targets.

583 Some High Frequency Measurements on a Cyclotron Model by Gunnar Lindström Arkiv Mat Astron Fysik 35A No.14 Pt 2 (1948) 10p

Experiments made to obtain information on the high frequency system for a 225 cm cyclotron now under construction at the Nobel Institute for Physics in Stockholm are described. Photographs of a scale model of the system on which the data were taken are shown. The high frequency system is the same type as that used for the 60-inch cyclotron in Berkeley. Theoretical calculations for the model are given. Curves of the percentage dee-voltage variation along the dees at $\lambda = 244$ cm and of the total dee-line length as a function of the wave length, measured with the model, are shown. A curve is also given showing the experimental values of the maximum dee-voltage differences as a function of wave length. The measured "Q" of the whole fuel scale system was found to be much less than the calculated "Q"—which is not too unusual as it is difficult to calculate the losses.

584 A Study of Expected Loss Rates in the Counting of Particles from Pulsed Sources by C H Westcott Proc Roy Soc 194A 508-526 (1948) Nov 9

The use in nuclear physics of accelerators giving a pulsed output leads to difficulties when electrical methods are used for detecting the particles produced. The counting losses due to the finite resolving time of the counting system are enhanced by reason of the pulsed nature of the source, and may become considerable unless the counting speed is kept quite low. Some calculations on the loss rates to be expected are given. It is desirable for the resolving time of the counting system, i.e., the dead time following each count, to be much shorter than the pulse length of the accelerator, but since this is itself usually only a few microseconds, this condition is not easy to achieve. If the dead-time is greater than the duration of the accelerator pulse, the calculations are relatively easy but the losses may be high. Calculations for intermediate cases show that the losses can be estimated fairly accurately, and results of practical value can be obtained up to fairly high counting speeds when the dead-time is as high as 40% of the pulse length. The accuracy with which the loss can be calculated will usually be limited by the uncertainty in the knowledge of the shape of the output pulse of the accelerator and of the exact length of the dead-time of the counting arrangement. The results of the calculations are summarized in the appendix.

585 A Travelling-Wave Linear Accelerator for 4-Mev Electrons by D W Fry, R B R -S - Harvie, L B Mullett and W Walkinshaw Nature 162 859-861, (1948) Nov 27

The same general design previously described (Nature 160 351 (1947)) for an accelerator capable of producing 0.5 Mev electrons has been applied to a machine which will accelerate electrons to the 4-Mev region. A schematic diagram and photograph are shown and the operating characteristics of the apparatus are discussed. The highest current which has so far been obtained in 60 microamp with a possible maximum of 150 microamp at 500 c/s, the highest magnetron recurrence-rate. The efficiency in terms of radio-frequency being fed into the accelerator is 30%.

PHYSICS, GENERAL

586 On the Capture of Electrons by Fast Ions by Julian K Knipp. AECD - 2430 nd Decl Dec 30 1948 26p Proposed for publication in Phys Rev Document for sale by AEC

The Oppenheimer-Brinkman-Kramers theory of the capture of electrons by alpha particles, in their passage through matter, is formulated in terms of a momentum representation of the electrons. For a heavy ion carrying a core of electrons, capture is largely into excited states. Total cross sections for such ions are estimated assuming hydrogen-like representations for the electron in the captured states and treating the atom from which capture takes place by the Thomas-Fermi model. See also MDDC - 1402, "The Capture of Electrons by Ions," by Julian K. Knipp.

587 The Application of the Bethe-Peierls Method to Ferromagnetism by P R Weiss Phys Rev 74 1493-1504 (1948) Nov 15

The method introduced by Bethe (Proc Roy Soc 150 552 (1935)) and Peierls (Proc Roy Soc 154 207 (1936)) for treating the problem of order-disorder in alloys is applied to the problem of ferromagnetism. The method is first applied to the Ising (Z Physik 31 253 (1925)) model of the spin in which case the treatment is much the same as it is for the alloy problem, as has already been pointed out by Peierls. The correct treatment of the spin is used for spin values of 1/2 and 1 per atom. The critical temperatures of different types of lattices are investigated. The method gives results in agreement with the rigorous results of the Bloch spin-wave theory (Zeitschrift für Physik 61 206 (1930)) in that only three-dimensional lattices are found to be ferromagnetic. The values of the critical temperatures of these lattices are found to lie between the values predicted by the two Heisenberg approximations. The discontinuity of the specific heat at the critical temperature is computed for a body-centered lattice and for the two values of the spin. The magnitude of the discontinuity is larger than that predicted by Heisenberg's first approximation. The magnitude for the spin 1 is 3.4 k per atom and compares favorably with the experimental value for iron. The susceptibility is computed as a function of the temperature above the critical point. The variation of the susceptibility with temperature does not obey the Curie-Weiss Law but displays some curvature. This curvature explains qualitatively the difference between the "paramagnetic" and ferromagnetic critical temperatures and also helps remove some of the discrepancy between the number of Bohr magnetons per atom as measured at high and low temperatures.

588 Contribution to the Mechanism of Secondary Emission. I. Absorption, on their Way to the Surface, of the Secondary Electrons Freed in a Solid Body (Beitrag zum Mechanismus der Sekundäremission I Absorption der im Festkörper ausgelösten Sekundärelektronen auf ihrem Weg zur Oberfläche) by O Hachenberg Ann Physik 2 Ser 6 404-416 (1948) (In German)

The possible elementary processes by which a secondary electron may give up its energy to a body are examined. The electron may suffer collisions with thermal lattice vibrations, lattice defects, free electrons in the body, and bound electrons. For this reason the electron can move only a limited distance. As a measure of this distance, the relaxation path "s" was chosen, which is the path the electron traverses until its initial energy has been lost to the e^{th} part. The relaxation path "s" is determined for several elementary processes, and its influence on the secondary emission is discussed for various bodies.

589 Intermolecular Forces and the Hydrogen Bond (Forces Intermoléculaires et Liaison Hydrogène) by Paul Rumpf Bull Soc Chim France No.3-4 211-230 (1948) Mar-Apr (In French)

This is a review containing discussions on the Van der Waal forces, the idea, experimental basis, and mechanism of the hydrogen bond. 108 references.

PHYSICS, GENERAL (continued)

590 Liquid Sodium Heat Transfer by F C Bennett. Dow Chemical Company Report No.14854 Oct 1948 23p (NP-514)

Information derived from previous operation of a plant and later experimental work is combined to give the following conclusions. Liquid sodium metal is found to be an excellent heat transfer medium if properly handled. Only pure sodium can be used in a heat transfer system if trouble is to be avoided. Distilled metal should be used without any exposure to the atmosphere. Heat transfer systems employing sodium should be protected by freeze traps which will precipitate and remove any dissolved solids. Sodium hydroxide, iron oxide, sodium hydride, or sodium oxide will cause plugs to form in a sodium system if present either singly or collectively.

591 Microwave Determination of the Molecular Structure of Chlorosilane by A Harry Sharbaugh Phys Rev 74 1870 (1948) Dec 15 (Letter to the editor)

The second rotational transition, J = 1 to J = 2, of SiH_3Cl^{35} and SiH_3Cl^{37} has been measured and analyzed using the Hughes-Wilson Stark modulation technique for detection of the absorption lines. The absorption frequencies were determined by comparison with a crystal-controlled secondary frequency standard. The observed microwave spectrum for monochlorsilane (SiH_3Cl), which is shown, was found to give satisfactory agreement with the theoretical hyperfine pattern for a nuclear spin of 3/2 for chlorine. Nuclear and molecular constants were calculated for the two forms of this compound (i.e., differing in the chlorine isotope) and are given in tabular form. It is noted that the Stark effect, as expected from theory, was strikingly observed.

592 On a Proposal for Determining the Thickness of the Transition Layer between Ferromagnetic Domains by a Neutron Polarization Experiment by R R Newton and C Kittel Phys Rev 74 1604-1605 (1948) Dec 1

The surface energy of the Bloch wall between ferromagnetic domains is of fundamental importance in domain theory (Bloch, Z Physik 74 295 (1932); Landau and Lifshitz, Physik Z Sowjetunion 8 153 (1935)); this energy can be computed if the wall thickness is known. It is proposed that the wall thickness be measured by studying the polarization changes of a neutron beam which is passed through a single Bloch wall. The relation connecting wall thickness, neutron velocity, and polarization change is derived; the required velocities are such that the experiment can probably be done with existing techniques, if grazing angles of incidence are used.

593 Proceedings of the American Physical Society Phys Rev 74 1888-1889 (1948) Dec 15

A meeting of the Ohio Section of the American Physical Society was held at Wilmington on October 30, 1948. Abstracts of the following papers, which were presented, are given: An Infra-Red "Lens," by Robert A. Oetjen; Measurement of Nuclear Magnetic Moments by Means of Super-Regenerative Oscillator Circuits, by John R. Zimmerman and Dudley Williams; Microwave Spectra of the Linear Molecules OCS, ClCn, and BrCn, by John D. Rogers and Dudley Williams; Microwave Absorption by Paramagnetic Salts, by Yu Ting, Roy C. Weidler, and Dudley Williams; Acoustical Birefringence, by William J. Price. In addition, the following papers were also presented: Electronic Method of Measuring X-Ray Intensities, by Nathan Spielberg; The Quartz Research Program at Antioch College, by C. Swinnerton; The Measurement of the Electrical Conductivity of Water Solutions Near the Critical Temperature, by Vernon Mathis; The Growth of Quartz Crystals in Sodium Chloride Solutions, by Thom McManus; A Theory of Quartz Crystal Growth, by James F. Corwin; Some Phenomena of Transonic and Supersonic Aerodynamics, by Bernard H. Goethert.

594 Vapor Pressure Data for Various Substances (A Graphical Presentation) by R R Law Rev Sci Instruments 19 920-922 (1948) Dec

Vapor pressure curves for the following elements and compounds commonly encountered in the fields of electronics and of high vacuum research are given in a single, useful chart: CO_2, Cl, SO_2, Br, H_2O, I, Fe, Ni, Mo, C, W, Kr, Xe, Hg, Cs, Rb, K, Cd, Na, Zn, Mg, Sr, Li, Ba, Bi, Pt, Ag, Cu, Al, Mn, Cr, Be, Au, Si, W, Ta. The primary source of data for the chart is the recent work of Ditchbourn and Gilmour (Revs Mod Phys 13 310 (1941)). Melting point data have also been included on the chart.

PHYSICS, NUCLEAR

595 The Atomic Nucleus, A New World To Conquer by I I Rabi Science 108 673-675 (1948) Dec 17

In non-technical language and making use of simple analogies, the author presents a brief description of the origin of our present picture of the nucleus and of the problems which remain to be solved in this connection.

596 The National Academy of Sciences Science 108 676-683 (1948) Dec 17

The following abstracts are included in the abstracts of papers presented at the Autumn 1948 meeting of the National Academy of Sciences at Berkeley, California. New Systematics in Alpha-Radioactivity, by Glenn T. Seaborg. The Thermodynamics of the System KHF_2, KF, HF, and the Nature of the Hydrogen Bond in KHF_2, by Kenneth S. Pitzer and Edgar F. Westrum. Relative Rates of Hydrolysis of Urea Containing C^{12} and C^{14}, by Albert L. Myerson and Farrington Daniels. Some Results Obtained with the 184-Inch Cyclotron, by Edwin M. McMillan. A Progress Report on the Cyclotron, by Ernest O. Lawrence. The Berkeley Linear Accelerator, by Luis W. Alvarez. The Magnetic Moments of Light Nuclei, by Felix Bloch.

597 Quarterly Report of Progress July 1 - Sept 30 1947 (Nuclear Physics Report No.11; Cosmic Ray's Report No.8). Washington University; St. Louis (Office of Naval Research Contract) 30p.

The cyclotron is being converted into an instrument more suitable for fundamental research in nuclear physics. A spectrograph was developed for the examination of high energy rays from Sb^{124}. The disintegration rate of P^{32} and I^{131} was determined. Progress is reported on the interaction between free mesons in the cosmic radiation and atomic nuclei and electrons.

PHYSICS, THEORETICAL

598 The Conservation of Energy, Momentum and Charge in the Nuclear Field by H T Flint and N Symonds Phil Mag 39 413-419 (1948) June

A paper previously published by one of the authors (Flint, Phil Magazine 38 22 (1947)) on "Energy in the Nuclear Field" is amplified. The principles of the theory are the same in both papers, although in this work a change in the sign of one component of the interaction between a nuclear particle and the nuclear field is suggested. The discussion is based on the assumption that the scalar field is associated with a modified form of Dirac's equation. The field is described in terms of vectors in a five-dimensional continuum, and an expression is obtained for the total energy density of the field and particle. It is noted that the nucleon in a scalar field appears to change its mass by a factor of

$$-(hg_k/2\pi)^2 e^{-kr_o}/4\pi r_o,$$

where k is the reciprocal of the fundamental length $h/2\pi M_o c$, associated with the nucleon.

599 Electrical Field Mechanics (Elektrische Feldmechanik) by Ludwig Flamm Acta Phys Aust 1 259-284 (1948) Abstract in Math Revs 9 551 (1948) Oct

In the theory presented, the elementary electric field associated with an electron is represented as "field matter" having inertial and elastic properties, while the magnetic field, which has no material existence, is associated with surface paths and velocities of the electric lines. The author shows that a transverse or "elementary electric" wave is propagated along the electric field line tube with the velocity of light. In the case of the homogeneous elementary electric field the elementary electric wave is a plane wave, which gives rise to an electromagnetic field satisfying Maxwell's equations in source-free regions. Formulas for the kinetic energy and impulse density are obtained and adapted to the dynamics of mass lines rather than mass points in studying the properties of field matter.

PHYSICS, THEORETICAL (continued)

600 A First-Order Approximation of the Density of the Nuclear Liquid (La densité d' energie du liquide nucléaire, approximation du premier ordre) by King Sing Nan Compt Rend 227 1157-1159 (1948) Nov 29 (In French)

Expressions for the potential and kinetic energy densities of a heavy nucleus of a liquid-like nature, as visualized by Bohr, are obtained. The Coulomb forces are assumed to be negligible for a first approximation. The perturbation method was used in making the calculations and although the calculation was carried to the second order, only the first order results are given.

601 A General Theory of Particles and Systems of Particles and Its Applications (Sur une Théorie Générale des Corpuscules et des Systèmes de Corpuscules et ses Applications) by Robert Murard Ann Phys 3 550-619 (1948) Sept-Oct (In French)

The fundamental principles of the theory of particles of Destouches ("Principes fondamentaux de Physique théorique," Paris, Hermann (1942)) are reviewed and applied to the determination of the wave equations and characteristic properties of a free electron, in particular those relevant to its spin. Using Destouches' approach, the theory of systems of particles is treated and a method of determining the interaction operator for a system of particles is demonstrated. The results are discussed with reference to the fundamental theory of such systems and to the problem of a particle placed in an external field.

602 The Invariant Form of Dirac Equations (Forme invariante des équations de Dirac) by F Van Bergen Bulletin de la classe des sciences, Académie royale de Belgique (5) 33 638-651 (1947)

After writing an arbitrary Lorentz transformation L^{σ}_{τ} in the form:

$$L^{\sigma}_{\rho} = (z\delta^{\sigma}_{} + z^{\alpha}Z^{\sigma}_{\alpha\tau})(\bar{z}\delta^{\tau}_{\rho} + \bar{z}^{\alpha}\bar{Z}^{\tau}_{\alpha\rho}),$$

where z, z^{α} are four complex numbers subject to a normalization condition: $z^2 + \Sigma^3_{\alpha=1}(z^{\alpha})^2 = 1$ and $Z^{\sigma\tau}_{\alpha} = Z^{\sigma}_{\alpha\rho}g^{\rho\tau}$ are a set of three anti-symmetric self-dual tensors, the author attempts to identify the four numbers (z,z^{α}) with the Dirac wave functions.

603 The Mass-Centre in the Restricted Theory of Relativity and its Connexion with the Quantum Theory of Elementary Particles by M H L Pryce Proc Roy Soc 195A No.1040 62-81 (1948) Nov 12

The Newtonian definition of the mass-center can be generalized to the restricted theory of relativity in several ways. Three in particular lead to fairly simple expressions in terms of instantaneous variables for quite general systems. Of these only one is independent of the frame in which it is defined and it suffers from the disadvantage that is its components do not commute (in classical mechanics, do not have zero Poisson brackets), and are therefore unsuitable as generalized co-ordinates in mechanics. Of the other two, one is particularly simply defined, and the other has commuting co-ordinates. The Poisson brackets can be derived from quite general considerations because the various mass-centers are expressible in terms of integrals of the energy-momentum tensor which are directly connected with the infinitesimal operators of the group of Lorentz transformations. The definitions are readily applicable to a single particle in theories, such as are current for elementary particles, where a co-ordinate observable does not exist, but an energy-momentum tensor does, and furnish the nearest approach possible to such observables. They are applied to electrons, particles of spin 0 and 1 (scalar- and vector-meson theories), and to photons.

604 Note on Dirac's Treatment of the Harmonic Oscillator by Peter T Landsberg Phil Magazine 39 1001-1004 (1948) Dec

Two infinite matrices introduced by Dirac in his theory of the harmonic oscillator are discussed. The author accounts for the surprising fact that two symmetrical matrices have the particular asymmetrical properties which Dirac ascribes to them, by indicating errors in the relations stated by Dirac.

PHYSICS, THEORETICAL (continued)

605 Note on Polarization Effects in Compton Scattering by A Wightman Phys Rev 74 1813-1818 (1948) Dec 15

A derivation of the probability of Compton scattering for an arbitrary initial and final photon polarization is outlined. The result is applied to the case of two successive Compton scatterings, and some possibilities of experimental verification are discussed. A simplification of the calculations of Compton scattering when used to analyze the polarization of annihilation quanta is also discussed.

606 On the Classical Theory of Particles by C Jayaratnam Eliezer Proc Roy Soc 194A 543-555 (1948) Nov 9

A set of classical relativistic equations of motion of an electron in an electromagnetic field is postulated. These equations are free from divergent solutions, and give the same results as the Maxwell-Lorentz theory for non-relativistic motions when the external electromagnetic field does not vary too rapidly. For the scattering of light by an electron, the scattering cross-section is independent of the frequency and is a universal constant. This brings out a point of difference from the Lorentz-Dirac equations according to which the scattering cross-section varies inversely as the square of the frequency of the incident light, for large frequencies. For the motion of an electron towards a fixed proton, the equations allow a collision, unlike the Lorentz-Dirac equations according to which the electron is brought to rest before it reaches the proton.

607 On the Electrodynamic Self-Energy of the Electron by E E Salpeter Proc Roy Soc 195A 163-173 (1948) Dec 7

The stationary-state wave equation for an electron at rest in a negative-energy state in interaction with only its own electromagnetic field is considered. Quantum electrodynamics, single-electron theory, and a "cut-off" procedure in momentum-space are used. Expressions in the form of expansions in powers of $e^2/\hbar c$ are derived for the wave function ψ and the energy-eigenvalue E by a method which (unlike perturbation theory) is not based on the assumption that the self-energy is small. The convergence of the expansion for E is not proved rigorously but the first few terms are shown to decrease rapidly. For low cut-off frequencies K_0 the expression for E behaves as the equivalent perturbation expression but for large K_0 it behaves as $-\nu\ (e^2/\hbar c)\hbar K_0$.

The variation principle is applied to an approximation (obtained from the expansion method) for ψ, and it is proved rigorously that for large K_0 the self-energy is algebraically less than or equal to $-\nu(e^2/\hbar c)\hbar K_0$. Hence, if the electron wave-equation is considered as the limiting case of the "cut-off" equation as $K_0 \to \infty$, it is established that the divergences obtained are not merely due to improper use of perturbation theory and that the self-energy is indeed infinite.

608 On the Possible Types of Interaction between Spinorial and Tensorial Fields by Satosi Watanabe Phys Rev 74 1864-1866 (1948) Dec 15

In a previous paper the author has pointed out that all the known spinorial and tensorial field equations can be written in covariant form in a five-dimensional flat space, in the absence of interactions, as: $ds^2 = (dx^1)^2 + (dx^2)^2 + (dx^3)^2 - (dx^0)^2 + (dx^5)^2$, in which x^5, the fifth coordinate, is considered as the canonical conjugate of the intrinsic mass (Scientific Papers of the Institute of Physical and Chemical Research (Tokyo) 39 157 (1941); 42 1 (1944)). The simplicity of the formulas thus obtained suggested the postulation of the five-dimensional covariance also as a heuristic principle to determine the correct formulation of the mutual interaction of fields. The results thus obtained are not unambiguously definable in the four-dimensional framework due, in the main, to ambiguities with respect to the definition of intrinsic mass. However, the postulate of five-dimensional covariance can be used as a criterion for the interaction types allowed from the proposed standpoint. In the case of an interaction between a spinorial (electronic or nucleonic) field and a tensorial (electromagnetic or vector) field the aforementioned postulate is compatible with only three types of interaction; if ψ is a spinor with four components having the same transformation property as the Dirac wave function, only three five-dimensional tensors can be obtained by combining its components, i.e., (1) a pseudo-scalar, (2) a vector,

PHYSICS, THEORETICAL (continued)

(3) a second-rank antisymmetric pseudo-tensor. It is found that of the corresponding five-dimensional invariants, which can be made by combining these tensors with the components of a tensorial field, the two latter types have successful applications in the actual wave fields. The possibilities of the pseudo-scalar type remain to be investigated. It is noted that most of the interaction types, including the Møller-Rosenfeld mixture, are not compatible with this covariance postulate.

609 Rayleigh-Ritz and A. Weinstein Methods for Approximation of Eigenvalues. I. Operators in a Hilbert Space. II. Differential Operators by N Aronszajn Proc Natl Acad of Sciences 34 474-480 594-601 (1948) Oct and Dec

Weinstein's method (Mémorial des sciences mathématiques 88 (1937)) giving lower bounds for the eigenvalues of a differential operator has been extended, simplified, and made more precise by the use of the Hilbert space theory. The method is described as a generalized counterpart of the Rayleigh-Ritz method (Journal für die reine und angewandte Mathematik 135 1 (1908); Courant, R., Bull Amer Math Soc 49 1 (1943)). The paper is presented in two parts; in the first part the theory for completely continuous, symmetric operators in a Hilbert space is developed, while in the second part the theory developed is applied to eigenvalue problems for differential operators.

610 The Self-Oscillations of a Charged Particle by D Bohm and M Weinstein Phys Rev 74 1789-1798 (1948) Dec 15

A consideration of the motions of a rigid, and therefore non-relativistic, extended charge has indicated the possibility of describing mesons and other kinds of particles as excited states of electrons. It is found that certain rigid charge distributions can oscillate without radiation even when no forces are present other than their own retarded fields. The periods are of the order of the time required for light to cross the particle. The energy of these oscillations is always positive, and there are therefore no exponentially increasing unstable motions of the type possessed by the Dirac classical electron. It is noted that the frequencies of these oscillations are such, that when quantized, the energy of the first excited state is of the order of the meson self-energy. Hence, it is suggested that some kinds of mesons may be electrons in such an excited state of self-oscillation. The possibility is indicated that the principle of causality may have to be reformulated in terms of causal connections over finite intervals of time, if one wishes to regard the electron and its associated electromagnetic field as a single system.

PUMPS

611 A Diffusion Pump Protection Switch by A J Croft J Sci Instruments 25 386 (1948) Nov

A water-operated relay, which can be inserted in the power supply leads of a diffusion pump to protect it from the damage which might result from failure in the cooling water supply, is described. The type diagrammed is suitable for laboratory use where the water outlet line is short and discharges into a sink.

612 The Speeds of Diffusion Pumps for Gases of Low Molecular Weight by J Blears and R W Hill Rev Sci Instruments 19 847-851 (1948) Dec

The evidence for a general relationship between the speed of a diffusion pump and the molecular weight of the gas being pumped is reviewed. Experiments are described which show that when pumps are operated at their normal ratings, the speeds for hydrogen and helium may be considerably lower than for nitrogen, and it is established that this is due to the relative ease with which the lighter molecules diffuse from the fore-vacuum to the high vacuum side of the jet. The speeds of diffusion pumps for different gases are not in fixed ratios, but in ratios which depend upon the fore-vacuum pressure and the heat input to the pump boiler. At heater wattages exceeding twice normal the inverse $(M)^{1/2}$ law may sometimes be obeyed.

RADIATION SICKNESS

613 Effect of BAL on Cobalt-induced Polycythemia in Rats by L O Jacobson, E K Marks and Evelyn Gaston Proc Soc Exptl Bio and Med 69 84-86 (1948) Oct

BAL (British Anti-Lewisite) in a dose of 0.2 millimole/kg given 3 times weekly fails to prevent, cure, or alter materially cobalt-induced polycythemia in rats. The general toxicity of BAL appears minimal when given in this dosage over a 3 1/2-month period. This experiment was made in preparation for a study of the effect of BAL on the biological effects and the excretion of radioarsenic (As^{76}).

614 The Negative Effect of Folic Acid on Irradiation Leukopenia in the Cat by William S Adams and John S Lawrence. Amer J Med Sci 216 656-660 (1948) Dec

The prophylactic and therapeutic administration of folic acid to cats did not alter the occurrence or the magnitude of leukopenia caused by exposure to 200 r whole body irradiation. 5 figures and 3 tables.

615 Radiation Sickness Brit Med J, No.4585 909-910 (1948) Nov 20

The cause of radiation sickness can probably be found in changes in the metabolism of cells which are sensitive to radiation. There is no general agreement on what the changes are, however. Breakdown of blood cells and release of substances, release of histamine, achlorhydric stomach, and change in endocrine function are all mentioned as possible causes. The following remedies are listed as having given good results in the hands of various workers: histaminase, "benadryl," hydrochloric acid, sodium chloride, magnesium chloride, high carbohydrate diet, large amounts of fluid, vitamin C, vitamin B, amphetamine, pancreatin, and pyridoxin. 8 references.

616 Vitamins and Radiation Injury Nutrition Revs 6 336-338 (1948) Nov

Goldfelder, Cohen, Miller and Singer (Proc Soc Exptl Bio and Med 67 272 (1948)) investigated the effects of dietary supplements of folic acid and of pyridoxime on the susceptibility of inbred Swiss mice to radiation injury. The first vitamin had been reported (Scott and Tarleton Radiology 47 386 (1946)) to be of clinical value in preventing nausea in x-ray-treated cases, while the second is of value in sprue and in treatment of leukopenia (Nutrition Revs 4 163 (1946)). Oral administration of folic acid (pteroylglutamic acid) for 7 days prior to radiation and 15 days thereafter had no obvious effect on the hematologic response, but there appeared to be a significant reduction in the number of deaths in the leukopenic phase. The average survival time of those animals receiving intramuscular injections was also greatly prolonged. Animals which received pyridoxime before irradiation, but not those which received it following, showed greatly prolonged survival times as compared with the control group. It did not appear to influence the onset or severity of the leukopenic phase, but it did reduce the number of deaths in this phase.

RADIOACTIVITY

617 The Beta-Ray Spectra of Cu^{64} by R D Albert and C S Wu. AECD - 2419 Dec 6 1948 Decl Dec 9 1948 1p

This document is an abstract; it is reproduced below in its entirety.

Positron and negatron spectra of Cu^{64} have been investigated in the Columbia helical focussing beta-ray spectrometer (Wu, Havens, Albert and Grimm Phys Rev 73 1259 (1948)). By using thinner and more uniform sources and employing a more rigorous Coulomb correction factor, the deviation at the low energy region was greatly reduced as compared with previous work (Backus Phys Rev 68 59 (1945; Cook and Langer Phys Rev 73 601(1948); Owen and Primakoff Phys Rev 74 1406 (1948)) reported from other laboratories. The observed electron distribution agrees with the theory from upper energy limit down to ~ 70 Kev. The deviation in the case of positron appears to start at a much higher energy ~ 200 Kev. However, the difference of the area under the momentum distribution curves between the experimental and theoretical distribution for both positrons and electrons is only about 1-2% of the total emission. It seems probable that the remaining small observed deviation is instrumental and the Cu^{64} spectra are in good agreement with Fermi theory. Further work on Cu^{64} is in progress.

RADIOACTIVITY (continued)

618 Beta-Ray Spectra of C^{14} by L Feldman and C S Wu. AECD - 2420 Dec 6 1948 Decl Dec 9 1948 1p

This document is an abstract; it is reproduced below in its entirety.

The beta-ray spectrum of C^{14} was investigated with the use of a helical focussing magnetic spectrometer. The very high specific activity carbon 14 (Norris and Snell Bull Amer Phys Soc No.3 46 (1948) Apr) (40 atom percent of C^{14}) was made available to us in the form of $BaCO_3$ by Norris and Snell of Oak Ridge. $BaCO_3$ was made into extremely thin and uniform sources of thickness around 15 $\mu g/cm^2$ by utilizing an ultra-sonic vibrator. Methods of reducing $BaCO_3$ to elementary form of carbon were extensively investigated. The counter window used is less than 30 $\mu g/cm^2$. The Fermi plot of the results gives a straight line from upper energy limit down to 25 Kev. Below 25 Kev, the Fermi plot begins to deviate slightly below the straight line probable due to the counter window effect. The end point obtained was 155 $\pm$ 1 Kev which is in good agreement with results reported from other laboratories (Berggren and Osborne Bull Amer Phys Soc No.3 46 (1948) Apr; Cook, Langer and Price Phys Rev 74 548 (1948)). This allowed distribution of the beta-ray spectra of C^{14} is reconcilable with the theoretical distribution for Δ I = 1 (yes) for both Fermi and Gamow-Teller selection rules.

619 The Beta-Ray Spectrum of RaE by R Morrissey and C S Wu. AECD - 2421 Dec 6 1948 Decl Dec 9 1948 1p

This document is an abstract; it is reproduced below in its entirety.

Investigations made in this laboratory of the β-ray spectra of Cu^{64} and S^{35} using very thin sources and backings and employing a refined Coulomb correction factor showed close agreement with Fermi theory from the upper energy limit down to the very low energy region. This led to a reexamination of the β-ray spectrum of RaE under similar experimental conditions. Carrier free RaE sources were prepared by electroplating RaE on a platinum electrode from a solution of RaD and E and then redissolving and depositing the RaE solution on a thin collodian backing (~6 $\mu g/cm^2$). The Fermi plot of the results after correcting for atomic screening effects still showed marked continuous curvature away from the energy axis over the entire region. This is in good agreement with the data of G. J. Neary (Proc Roy Soc 175A 71 (1940)) from upper energy limit to ~ 180 Kev. Below 180 Kev our Fermi plot continues to curve concave upward while Hearn's reaches a maximum and then drops off rapidly. The fitting of C_2T (the second forbidden correction factor for tensor interaction) to RaE data will be discussed.

620 Alpha-Decay Systematics of the Heavy Elements by I Perlman, A Ghiorso and G T Seaborg Phys Rev 74 1730-1732 (1948) Dec 1 (Letter to the editor)

The α-decay energy as a function of mass number is shown for mass numbers 198 (Bi) to 242 (Am). Data for many of the newer isotopes shown are given in the recent review of Seaborg and Perlman (Revs Mod Phys 20 (1948) Oct). The nearly parallel increase in α-energy with decreasing mass number starting with the heaviest isotope for each is noted for the elements from bismuth to curium. Other correlations are made and briefly interpreted. Further correlations of α-decay energies with half-lives and β-stability will be presented in a later paper.

621 The Alpha-Ray Spectrum of Polonium by Walter G Wadey Phys Rev 74 1846-1853 (1948) Dec 15

Measurements of the alpha-ray spectra of polonium mounted on nickel, silver, and cadmium by means of a 180-degree-focusing magnetic spectrograph are reported and discussed. The weak line series reported by Chang (Phys Rev 69 60 (1946)) was not apparent. The hypothesis is proposed that the alpha-ray spectra seen to date have not been caused by the element polonium, but by the diffusion of the polonium into the mounting metal.

RADIOACTIVITY (continued)

622 The Beta-Decay Spectra of B^{12} and Li^8 by W F Hornyak, C B Dougherty and T Lauritsen Phys Rev 74 1727-1728 (1948) Dec 1 (Letter to the editor)

The β-spectra of Li^8 and B^{12} were studied using a magnetic lens spectrometer in the region from 500 Kev to well above their end-points. The activities were obtained by bombarding a thin foil of lithium metal and a thin deposit of B_2O_3 with deuterons of 770 and 1200 Kev, respectively. The momentum spectra of electrons from Li^8 and B^{12} and the Kurie plots for the two isotopes are given. The end points for B^{12} and Li^8 were determined as 13.43 $\pm$ 0.06 Mev and 12.7 Mev, respectively. The former is in agreement with Hereford's (Phys Rev 74 574 (1948)) and the latter is consistent with α-particle data.

623 β-Disintegration and the Sargent Diagram by N Feather and H O W Richardson Proc Phys Soc 61 452-466 (1948) Nov 1

Sargent diagrams constructed for negatron (negative-electron)-active species having $80 < Z < 94$ (as also for the restricted group with $80 < Z < 84$), and for both negatron-active and positron-active species having $Z < 22$, are discussed in the light of theory. The majority of first-forbidden transitions in the group of heaviest radioelements give a Sargent line parallel to the allowed line, corresponding to disintegration constants smaller than the disintegration constants of allowed transitions of equal energy by a factor of roughly 10. Transitions with no parity change between states of zero spin appear to give a second-forbidden line also parallel to the allowed line.

With the lightest radioelements "super-allowed" transitions are identified which require Wigner selection rules for their interpretation, but there is also a group of transitions which appears to be ordinarily allowed (i.e., subject to spin and parity selection rules only). Compared with these allowed transitions in the lightest elements, allowed transitions in the heaviest radioelements are less probable by a factor of only about three, when comparison is made for equal energy release and account is taken of the effect of the coulomb field of the nucleus.

On the assumption that all even-even nuclei have even parity and zero spin in the ground state it is concluded that the β-particles of maximum energy observed with RaB, RaC, and $MsTh_1$ are emitted in transitions to excited states of the final nuclei RaC, RaC′ and $MsTh_2$, respectively. This conclusion makes it likely that the accepted value of the total γ-ray emission from RaB (Gray 1937) is too small, that the total disintegration energy Ra.C.C′ is 3.78 Mev and that $MsTh_1$ emits a low-energy γ-radiation which has not as yet been detected. On the same assumption it is concluded that the disintegrations $UX_1.UX_2'$ and $UX_2.U_{II}$ possess features at present unknown or insufficiently understood.

624 Coincidence Experiments on 5.3y Co^{60} by A Mukherji and S Das Indian J Phys 22 311-315 (1948) July

The isotope Co^{60} of 5.3-year half-life, which has been previously studied by Das and Saha (Proc Natl Inst Sci India 12 227 (1946)), has been further investigated to arrive at the level scheme of the nucleus. The theory of coincidence measurements is discussed preliminary to a description of the beta-gamma and gamma-gamma coincidence measurements which were made. The data are given in tabular form and indicate that the β-emission is followed by the emission of two gamma rays in accordance with the level scheme of Deutsch and Elliot (Phys Rev 68 193 (1945)), rather than that given by Nelson, Pool, and Kurbatov (Phys Rev 62 1 (1942)), in which only one gamma ray is emitted. From Cu foil absorption measurements, the gamma rays were found to have an average energy of 1.2 Mev. There was no angular asymmetry detected in the gamma-gamma studies.

625 Dependence of β-Decay on the Sign of the Change in Nuclear Spin by C Strachan Proc Phys Soc 61 481-482 (1948) Nov 1 (Letter to the editor)

The calculation of the probability of β-decay for given values of the magnitudes of the initial and final angular momenta of the nucleus may be abbreviated, as has been done by Marshak (Phys Rev 61, p. 431, 1942), by application of a sum rule and the principle of conservation of angular momentum. A discrepancy between Marshak's results and those obtained by Greuling (Phys Rev 61, p. 568, 1942) is noted. The author amplifies the former and indicates the error in Greuling's statement.

RADIOACTIVITY (continued)

626 **On the Theory of the Recoil in β-Decay by O Kofoed-Hansen** Phys Rev 74 1785-1788 (1948) Dec 15

On the basis of the Fermi theory of β-decay a formula for the recoil spectrum is derived, and the average values of the momentum and energy of the recoil are calculated. Some properties of the recoil spectrum are discussed in the case when the β-decay is followed by γ-ray emission. It is shown that the average recoil energy is independent of a possible angular correlation between successive β- and γ-rays. Finally the influence of a finite mass of the neutrino and the neglect of the kinetic energy of the recoil in the energy balance is discussed.

627 **Determination of the Maximum Energy of the β-Radiation of S^{35} by L Yaffe and Katharine M Justus** Can J Research 26B 734-736 (1948) Oct

The maximum energy of the β-particles from S^{35} has been determined as 169 $\pm$ 5 Kev by means of aluminum absorption measurements. From the latter, the range was determined to be 32.2 mg/cm^2. Numerous other investigators have obtained values ranging from (107 $\pm$ 20) to (169 $\pm$ 3) Kev using various techniques. The absorption curve is shown.

628 **The Energy-Half-Life Relation of the α-Emitter Radioelements (Sur la relation energie-periode des radioéléments α-émetteurs) by André Berthelot** Compt Rend 227 829-831 (1948) Oct 27 (In French)

From experimental data taken during the past few years, the constants in the expression relating the half-life and energy of disintegration of α-particle emitters previously discussed (J Phys et Radium (8)3 52 (1942)) have been determined giving the following relationship:

$$\mathrm{Log}_{10}T = -17.70 + 0.870\, Z^{1/2} A^{1/6} \gamma \left(0.643 \frac{EA}{Z'}^{1/3}\right) \qquad (1)$$

in which Z′ and A′ refer to the charge and mass numbers, respectively, of the residual nucleus, and E is the energy of disintegration. The function "γ" in the above expression is defined as

$$\gamma(x) = x^{-1/2} \arccos x^{1/2} - (1-x)^{1/2} \qquad (2)$$

Curves obtained using (1) are shown for Z-values in the 82-92 range, using a mean value of A in each case, i.e., A-values of 211, 216, 220, 225, 230, 234, and 238 for Z-values of 82, 84, 86, 88, 90, and 92, respectively. The experimental points obtained in numerous investigations of α-emitters are compared with the curves. It is noted that: (a) 32 of the 52 points lie on the calculated curve or depart from it by values corresponding to a variation of 100 Kev or less in E; (b) the half-lives of elements of uneven "Z" are frequently slightly higher than would be predicted from the corresponding energies; (c) the half-lives of elements which must subtract one or more nucleons from the "condensed nucleus" (J Physique et Radium (8)3 17-28 (1942)) before α-emission, are higher than predicted by expression (1). Discrepancies were observed for the following: Th^{232}, U^{235}, Po^{211}, and Fr^{219}.

629 **Experimental Upper Limit for the Mean Life of the 478.5-Kev Excited State of Li^7 by L G Elliott and R E Bell** Phys Rev 74 1869-1870 (1948) Dec 15 (Letter to the editor)

The gamma rays emitted by the Li^{7*} formed during the reaction $B^{10}(n,\alpha)Li^7$ (when the short-range alpha group is emitted) have been studied by means of the photoelectrons they produce in a Au foil. The K photoelectron spectrum observed using a magnetic-lens beta spectrometer is shown. The energy of the gamma ray was determined as 478.5 $\pm$ 1.5 Kev, which is in agreement with earlier values. From the Q of the reaction, 2.83 $\pm$ 0.11 Mev, the velocity of the Li^7 nucleus can be determined. Using the data obtained, the upper limit of the mean life of Li^{7*} is estimated as 2.0×10^{-13} sec. Assuming an angular momentum of 3/2 for the ground state of Li^7 and 1/2 for Li^{7*}, the transition takes place by magnetic dipole radiation and the transition probability can be calculated. The calculated mean life of 1.5×10^{-13} sec for the excited state, which is thus obtained, is consistent with the experimental upper limit.

RADIOACTIVITY (continued)

630 Fine Structure of the Magnetic Spectrum of α-Rays of Ionium (Structure fine du spectre magnétique des rayons α de l'ionium) by Salomon Rosenblum, Manuel Valadares and Jeannine Vial Compt Rend 227 1088-1090 (1948) Nov 22 (In French)

Using as source of Io-Th an electrolytic deposit on Pt made in 1945 (27% Io), the authors studied the magnetic spectrum of the α-radiation of Io from long-exposure photographs (4 to 21 days) submitted to a microscopic counting. From a simultaneously obtained α-spectrum of ThC a ratio was obtained which permitted the assigning of a value of 4682 $\pm$ 10 Kev to the energy of the most rapid group of Io. This group is separated from another, of a similar order of intensity, by 69 Kev. A still slower group seems to exist at 170 Kev from the first one (cf Ward, Proc Cambridge Phil Soc 35 322 (1939)). There are indications that the groups are of a complex nature, which points to the possible existence either of a soft gamma spectrum or of a complicated beta spectrum. The presence of Ra accumulated since 1945 is visible on the spectra obtained; in a few years it will be possible to determine directly, by the method used, the half life of Ra.

631 Metastable State of Sc^{46} by M Goldhaber and C O Muehlhause Phys Rev 74 1877-1878 (1948) Dec 15 (Letter to the editor)

Curves for the decay of 20-sec Sc^{46} and for the absorption of the photon and electron components in lead and aluminum, respectively, are shown. The activity was obtained by slow neutron bombardment of Sc in its oxide. The following were among the data obtained: (1) the internal conversion electron range is about 30 mg/cm^2 corresponding to an energy of 165 Kev; (2) a value of 180 Kev was obtained for the gamma-ray energy; (3) the ratio of internal conversion electrons to gamma rays was about unity, which is compatible with a "2^4-pole" isomeric transition; (4) the "pile neutron" absorption cross section was determined as approximately 10 x 10^{-24} cm^2 and an appreciable fraction of the ground state must, therefore, be formed through the metastable state. Cadmium absorption data taken indicate that a negative energy neutron level is responsible for the strong absorption of thermal neutrons in Sc.

632 On the Half-Life of Rb^{87} by O Haxel, F G Houtermans and M Kemmerich Phys Rev 74 1886-1887 (1948) Dec 15 (Letter to the editor)

Previous values which have been obtained for the half-life of Rb^{87} have differed widely, lying in the range (4.5 – 12) x 10^{10} years. A new determination has been made by means of two series of experiments in which the rate of beta-particle emission per mg of RbCl was measured. Using layers of RbCl evaporated on a silver-coated zapon foil suspended between counters, the values found were n = 27.2 decays/mg RbCl/min and T = (6.5 $\pm$ 0.6) x 10^{10} years. A redetermination which was made on 60 cm^2 areas which were covered by RbCl by evaporation on Al foils and were placed on the inside wall of a G-M counter. In this case the values were found to be n = 30.7 decays/min/mg RbCl and T = (5.8 $\pm$ 0.5) x 10^{10} years. As a weighed average of both sets of experiments, the half-life was calculated as (6.5 $\pm$ 0.6) x 10^{10} years, which is in fair agreement with the geological value obtained by Mattauch (Naturwissenschaften 25 189 (1937)) of 6.4 x 10^{10} years. A full account of these experiments will be published soon.

633 On the Virtual Excited State of the Be^9 Nucleus by Conrad Longmire Phys Rev 74 1773-1775 (1948) Dec 15

An attempt has been made, on the basis of a simple model, to understand the energy and width of the virtual level of the Be^9 nucleus, which was found by Davis and Hafner by inelastic scattering of protons from Be^9 (Physical Review 73 1473 (1948)). The model used for the Be^9 nucleus was that of a neutron moving in a potential well provided by the remainder of the nucleus. There is no striking agreement numerically between the model and experiment, but a loose interpretation by means of the model is possible.

RADIOACTIVITY (continued)

634 Radiations from Te^{121} by R D Hill and J W Mihelich Phys Rev 74 1874 (1948) Dec 15 (Letter to the editor)

More precise measurements have been made of the energies of the internal conversion electrons from the 143-day half-life isomeric transition of Te^{121} which has been previously reported (Burson, Bittencourt, Duffield, and Goldhaber, Phys Rev 70 566 (1946)). The conversion electron spectrum obtained using a 180-degree focusing beta-ray spectrograph, along with the associated gamma-ray energies, is shown in tabular form. The spectrum, which is shown, is fairly complex, consisting of 18 lines. Four of these lines have previously been assigned to Te^{122} or Te^{124}. The following have also been obtained: (1) the K-L conversion ratios for the various transitions, (2) the effective angular momentum changes associated with 2^1- electric multipole transitions and the associated lifetimes, (3) the relative intensities of the conversion electrons from all shells for the separate transitions.

635 The Radioactive Decay of K^{40*} by L B Borst and J J Floyd Phys Rev 74 989-990 (1948) Oct 15 (Letter to the editor)

Data taken on the radioactive decay of K^{40} by β-emission indicate a half-life of 4-12 x 10^8 years. This value is somewhat higher than those obtained by Bleuler and Gabriel (Helv Phys Acta 20 67 (1947)) and Ahrens and Evans (Phys Rev 74 279 (1948)). The value is discussed with reference to the age of existing rocks. The partial disintegration constant for β-emission was determined by aluminum absorption measurements to be (3.9 $\pm$ 0.4) x 10^{-10} per year, which is smaller than previous values obtained by Ahrens and Evans, Bleuler and Gabriel, and Mülhoff (Ann Physik 7 205 (1930)). The Feather analysis is shown for aluminum absorption measurements; a range corresponding to a maximum β-energy of 1.9 $\pm$ 0.2 Mev is indicated. This is higher than previous values, such as that recently reported by Franchetti and Giovanozzi (Rend Accad Naz Lincei 1 1078 (1946); Phys Rev 74 102 (1948)). The question of whether the γ-radiation emitted is associated with electron capture decay rather than with electron emission because of the supposed deficiency of mass difference between K^{40} and Ca^{40} is discussed. The argon content of a sample of Permian sylvite about 2 x 10^8 years old was determined by collection of the total permanent gas obtained on dissolving in air-free water. From this the partial disintegration constant for electron capture is calculated as about 2.8 x 10^{-10} per year. From various considerations it is concluded that the value probably lies in the range between 2 and 12 x 10^{-10} per year. The total disintegration constant is given as about (5.9 – 16.5) x 10^{-10} per year. The estimated isotopic abundance of K^{40} at the time of nucleogenesis is 0.5%. In addition the estimated current heat output of natural potassium from λ_β and an average β-energy of 0.6 Mev and the known γ-energy output is now considered to be 20 microcal./yr per gram of potassium, and the value at the time of petrogenesis ($\sim$2.4 x 10^9 B.C.) was roughly sixteen times as great — 300 microcal./yr per gram of potassium.

636 Remarks with Respect to a Note by Felix Ehrenhaft and H Herzog (Remarques à propos d'une Note de MM. Félix Ehrenhaft et H Herzog) by Aimé Cotton, Eugene Cotton and Pierre Tauzin Compt Rend 227 794-797 (1948) Oct 27 (In French)

The authors comment on the recent work of Ehrenhaft and Herzog (Compt Rend 227 626 (1948)) in which they observed that Ra-E radiations which would not blacken a photographic plate through an interposed 1.8 mm foil of aluminum would pass through up to 3 mm of aluminum and blacken the plate in the presence of an 11,000-gauss magnetic field. The authors consider the effects of such a field on the trajectories of electrons in motion, i.e., β-rays. It is shown that a helical trajectory may result which would tend to concentrate the β-radiation in a well-defined area on the plaque, the number of electrons received in this region being approximately 3.4 times as many as received in the absence of the field. Since Ehrenhaft and Herzog have not specified the strength of their source, further work will be necessary to verify whether this effect would be sufficient to account for the blackening observed. It is also noted that the possibility that such an effect could be observed in the absence of the field after the lapse of sufficient time to compensate for the lower intensity has not been investigated. Also, in the presence of a magnetic field, the plate may become more sensitive to radiations. Investigations of the aforementioned possibilities are now in progress.

RADIOACTIVITY (continued)

637 The Search for the Neutrino through Nuclear Recoil Experiments by James S Allen Amer J Phy 16 451-461 (1948) Dec

The various experimental attempts to establish the existence of the neutrino are reviewed. The study of nuclear recoils from K-capture, gaseous sources at low pressures, and thin sources is discussed, and the production of nuclear recoils from the decay of Li^8 is also treated. This reaction is unique in that the daughter-nucleus breaks up into two α-particles. 12 figures. 30 references.

638 Some New Radioactive Isotopes of Tb, Ho, Tm, Lu, Ta, W, and Re by Geoffrey Wilkinson and Harry G Hicks Phys Rev 74 1733-1734 (1948) Dec 1 (Letter to the editor)

This article is based upon AECD - 2306. An abstract of this document has been listed in Nuclear Science Abstracts as Abstract I-1277.

639 Tc^{92} and Tc^{93} by Relative Cross-Section Measurements by D N Kundu and M L Pool Phys Rev 74 1775-1781 (1948) Dec 15

Under 5-Mev proton and 10-Mev deuteron bombardments on natural Mo and on electromagnetically enriched Mo isotopes, activities of 2.7-hour, 47-minute, and 4.5-minute half-lives are found to be produced from Mo^{92}. The relative cross sections for the production of these activities are 25:127:1, respectively. On comparing these figures with those for the (p,n): (p,γ) reactions from Mo^{95}, the 47-minute activity is assigned to Tc^{92}, and the 2.7-hour and the 4.5-minute activities to Tc^{93}. It was found that Tc^{92} decays by K-capture with the emission of 1.5-Mev γ-rays. For the 2.7-hour Tc^{93}, 93% decays by K-capture and 7% by emission of positrons of 0.83 Mev maximum energy; γ-rays of energy 2.0 Mev are also associated with this activity. Decay curves are shown for the various activities observed.

640 Use of Enriched Molybdenum in Cross-Section Measurements of the (p,n): (p,γ) and (d,n): (d,2n) Reactions by D N Kundu and M L Pool Phys Rev 74 1574-1576 (1948) Dec 1

Molybdenum of natural isotopic composition and molybdenum enriched in isotope 94 were subjected to bombardments with protons and deuterons. Simultaneous equations were set up, after monitoring, from the saturation intensities and nature of the decay of the radioactive substances produced. These equations were used to obtain the following relative values for the reaction cross sections: (1) for 5-Mev protons, Mo^{94}(p,γ): Mo^{95}(p,n): Mo^{95}(p,γ): Mo^{96}(p,n) = 1: 260: 40: 400; (2) for 10-Mev deuterons, Mo^{94}(d,n): Mo^{95}(d,2n): Mo^{95}(d,n): Mo^{96}(d,2n) = 1: 13: 17: 2.5. The method is applicable to a wide range of elements.

RADIOTHERAPY

641 First Betatron Treatment of Patients J Amer Pharm Assoc Practical Pharmacy Edition 9 620 (1948) Oct

First betatron treatment of patients with deep-seated cancer will be likely in 1949. The high energy x-rays, 20 times more powerful, will come from the new betatron to be installed at the University of Illinois College of Medicine. It is the world's first installation of a betatron for cancer treatment and research, university officials report.

642 Isotopes in Neoplastic Disease by J H Lawrence Rocky Mountain Med J 45 980-984 (1948) Nov

Three ways in which isotopes are concerned in the problem of neoplastic disease are discussed briefly in this review. They are their carcinogenic properties, their use as tracers in studies on the nature of the cancer cell, and their therapeutic use as sources of destructive irradiation.

RADIOTHERAPY (continued)

643 Post-Irradiation Neuropathy by Maurice M Greenfield and Frederick M Stark Amer J Roentgenol and Radium Ther 60 617-622 (1948) Nov

In a series of 180 cases of carcinoma of the testis treated by intensive million volt X-ray therapy, 3 patients developed a peculiar neurologic disturbance. The principal feature in each case was a flaccid paralysis of the lower extremities without sensory loss. The authors have called this syndrome "post-hyphenate irradiation neuropathy" and, to their knowledge, it has not been previously described. The chief site of nerve injury was believed to be the anterior horn cells in the lumbosacral segments of the spinal cord. The 3 case reports are given.

644 Radioisotopes, Their Meaning to Pharmacy and Medicine Mod Pharmacy 33 No.6 5-17 (1948) Nov

This is a well-illustrated presentation of the newest frontier being explored by pharmaceutical research. The article briefly discusses what radioisotopes are, their fundamental chemistry and physics, how they are made, their therapeutic potentialities, and their use in the pharmaceutical research laboratory. 25 illustrations and figures.

645 Radio-Isotopes: Their Production and Uses by C E Eddy Med J Australia 2 537-539 (1948) Nov 6

This review is by a physicist. He points out to his medical audience that the administration of radioisotopes requires the services of experienced physicists in the preparation of samples with the correct dosage, in the determination of the amounts which have been absorbed by the patient, in the assay of selected fluids and tissues, and finally in the ensuring of methods of protecting both patient and hospital staff from over-exposure to radiation.

646 The Use of Radioiodine in the Treatment of Exophthalmic Goiter by S F Haines, F R Keating Jr, M H Power, M D Williams and M P Kelsey J Clin Endocrinol 8 813-825 (1948) Oct

Because of the possibility of late effects on the thyroid and other glands, only persons for whom the risk and the difficulties of other methods appeared excessive were given therapeutic doses of radioiodine. These 40 patients also represented a group with not only severe conditions, but also conditions that had proved resistant to the usual forms of treatment. Doses that would allow collection of approximately 200 to 250 microcuries per gram of estimated thyroid weight were given orally and varied from 2600 to 20,000 microcuries. Immediate reactions were unimportant. From a single dose 20 patients showed good results, which were indicated by a lowering of the basal metabolism rate to plus 15% or further by the euthyroid state of the patient; 8 patients showed fair results, and 5, poor results. Myxedema developed in 7 patients. Patients obtaining good results from a single dose received an average dose of 242 microcuries per gram of thyroid tissue; those obtaining fair results, 239 microcuries per gram; and those having poor results, 151 microcuries per gram. There is probably great individual variation in sensitivity to radiation, but the ability of radioiodine to control severe exophthalmic goiter, at least temporarily, seems definite. 11 references and 3 tables.

RARE EARTHS

647 Study of the 2y Eu^{155} in Fission by L Winberg. AECU-35(ANL-NS-28)nd 6p

A 2y Eu isotope of mass 155 has been found which decays by means of a 0.2 Mev β and a 0.08 Mev γ. There are conflicting data on the fission yield of this isotope. The best weighted average is $\sim$0.03 percent. For a mass assignment of 155 this value fits the fission yield curve. Recent work elsewhere indicates the parent of 2y Eu^{155} to be a 25m Sm isotope emitting 1.9 Mev β and 0.3 Mev γ radiations and having a fission yield in U^{235} of 0.031 percent.

RARE EARTHS (continued)

648 Note on the Arc Spectrum of Element 61 by C Feldman. AECU-52 (ORNL-210) Nov 24 1948 6p

A sample of element 61 previously separated from uranium fission products was prepared in the form of approximately 0.05 ml of an HCl solution. The burning took place inside a chamber which permitted the radiation to enter the spectrograph without allowing the vapor containing element 61, which is highly radioactive, to escape into the laboratory. A first order spectrum (5 A/mm) was photographed in two 2 inches by 10 inches 103F plates in tandem. No filter was used. Spectra of Fe, Nd, element 61, and Sm were obtained in juxtaposition in the order mentioned. The placement of the spectra on the plate was effected by means of a Hartmann diaphragm at the slit; the camera was not moved at any time during the exposure. The spectrum showed the presence of comparatively large amounts of Ca and Mg, and moderate amounts of Fe, Ni, and Cr. Although no definite line was seen at 3305.8, the proximity of Fe 3305.98 might mask a weak line at 3305.8. A line was observed at 3342.5, but this line may have been Cr 3342.586.

649 Cathodo-Luminescence Spectra of Indian Calcites, Limestones, Dolomites and Aragonites by Bibhuti Mukherjee Indian J Phys 22 305-310 (1948) July

The cathodo-luminescence spectra of Indian calcites, limestones, dolomites, and aragonites were studied in the visible and ultra-violet regions, using a direct vision spectrograph and a Fuess quartz spectrograph. From these it was determined that the rare earth luminescence activators in the calcites were Sm, Dy, Eu, and Er; in the dolomites Dy and probably Sm and Eu were activators, whereas in the aragonites the only rare earth activator was Dy. It is noted that with the exception of Eu, the rare earths with even atomic number were the chief luminescence activators. When rare-earths were present in calcite in optimum quantity for strong activating ability, the luminescence spectrum of Mn in the visible region was totally suppressed by the activating effect of the rare earths. Below this optimum, both Mn and the rare earths effected luminescence. The position of the band due to the rare-earths in the luminescence spectrum of calcite, dolomite, and aragonite was the same as that in fluorite, which indicated that the limitations placed upon the activating rare-earth atoms by the neighboring atoms were the same in all these minerals. It was found that strontium and thallium showed no characteristic luminescence because of the strong activating ability of traces of manganese in CaO.

650 The Conductivity of Aqueous Solutions of Lanthanum Ferricyanide by C W Davies and J C James Proc Roy Soc 195A No.1040 116-123 (1948) Nov 12

The conductivity of lanthanum ferricyanide in water has been measured at 18, 25, and 30°C. In dilute solutions the salt shows the behavior of a comparatively weak electrolyte, and when the limiting Debye-Hückel and Onsager equations are applied to thirty measurements at ionic strengths lower than 0.002, a constant value $K = 1.82 \times 10^{-4}$ is found for its dissociation constant at 25°C. The dissociation constants at 18 and 30°C have also been calculated, and hence ΔH, ΔG, and ΔS for dissociation. At the higher concentrations the conductivity curve shows abnormalities which find a reasonable explanation in the theory that the degree of dissociation falls to a minimum value of approximately 0.5, and increases again at higher concentrations. The composition of the hydrate stable at room temperature is found to be $LaFe(CN)_6 \cdot 5H_2O$. One molecule of water is readily lost over concentrated sulfuric acid, and this may account for the lower degrees of hydration reported in the literature.

651 History of the Discovery of an Element: 61(Histoire de la découverte d'un élément: le 61) by H Haissinsky Rev Gén Sci 55 170-171 (1948) (In French)

This is a note on the history of the discovery of the element with the atomic number 61, starting with Hopkins' observations in 1926 and ending with the work of Marinsky and Glendinin in 1947.

RARE EARTHS (continued)

652 Investigations of Rare Earth Problems-Quarterly Progress Report No. 10 for the Period September 1 to December 1, 1948. University of Illinois (Office of Naval Research Contract) nd 49p (NP-510)

The report concerns work on spectrophotometric studies of the rare earths, ion-exchange studies involving the lanthanons, the stabilization of the higher valence states of praseodymium, composition and structure of the oxides and hydrous oxides of praseodymium, the phosphoric acid derivatives of the rare earths, hypophosphate studies, and 8-hydroxyquinoline and substituted 8-hydroxyquinoline derivatives of the rare earth elements.

653 A New Naturally Occurring Isotope of Dysprosium by David C Hess Jr and Mark G Inghram Phys Rev 74 1724-1725 (1948) Dec 1

This article is based upon AECD - 2321. An abstract of this document appeared in Nuclear Science Abstracts as Abstract No. I-1333.

654 On the Existence of Organometallic Compounds of the Lanthanides (K Voprosu o Sushchestvovanii Metalloorganicheskikh Soedinenii Lantanidov) by B N Afanas' ev and P A Tsyganova Zhur Obshchei Khimii 18 306-307 (1948) Feb (In Russian)

According to A von Grosse (Z Anorganische Chemie 152 133 (1926)), stable organometallic compounds are formed only by those elements whose valence electrons all have the same quantum number. Except for the non-typical tetramethyl-platinum, this rule has no exceptions. Therefore, it was surprising to find a description of very stable etherates of triethyl-scandium and triethyl-yttrium given by W M Pletz (Doklady Akad Nauk 20 27 (1938)). The present authors decided to attempt a synthesis of similar compounds for other elements of the same group, starting with one of the lanthanum family. In the experiment described they added an ether solution of $BrMgC_2H_5$ to a suspension in ether of $ErCl_3$. No reaction followed. The authors concluded it is generally impossible to form stable alkyl derivatives, or their etherates, of rare earths.

SCIENTIFIC RESEARCH AND LABORATORIES

655 Medical Program of the Atomic Energy Commission by Shields Warren J Amer Med Assoc 138 1227-1228 (1948) Dec 25

The medical program of the Atomic Energy Commission may be divided into 5 parts: (1) the maintenance of health of the workers of the commission and its contractors; (2) protection of environmental health through proper waste disposal and avoidance of contaminating surrounding areas; (3) the development of basic research in the effects of ionizing radiation on the plant, animal and human cell, both isolated and aggregated; (4) the exploration of what, if any, values the new sources of energy available at the installations of the Atomic Energy Commission themselves and the value that very short-lived radioactive isotopes may have in cancer research and cancer therapy; and (5) development of a training program for scientific personnel.

656 Norwegian Atomic Research Chem and Eng News 26 3780 (1948) Dec 20

Norway's atomic research center is now under construction at Kjeller, near Oslo. Norwegian uranium and heavy water, sufficient for construction of an atomic pile for experimental purposes, are now being mined and processed.

SPECTROSCOPY

657 The Hyperfine Structure of Tritium by E B Nelson and J E Nafe. AECD - 2431 (CUD-15; DR-1096) Dec 6 1948 Decl Dec 29, 1948 18p Proposed for publication in Phys Rev Document for sale by AEC

An abstract of this document was assigned the number AECD - 2350. This abstract has been listed in Nuclear Science Abstracts as Abstract No. I-1720

SPECTROSCOPY (continued)

658 Note on Improvements in Spectrochemical Techniques by E H Leslie. AECU-48 (K-325) Dec 28 1948 11p

A method of mounting small, odd-shaped steel samples for spectrochemical analysis using silver solder is presented. Statistical data on analyses performed on samples mounted in this manner as compared with identical but unmounted samples show that comparable results are obtained. The "Handy Punch," a device used to produce the vent hole in the sample charge in the carrier distillation method of spectrochemical analysis for trace impurities in uranium base materials, is described.

659 Infra-Red Spectrometer Recording System by John Hovorka and Edward A Dunlap Jr Rev Sci Instruments 19 915-916 (1948) Dec

An infra-red spectrum recorder for use with the Perkin-Elmer Model 12A spectrometer has been designed which has the advantages of high sensitivity, inherent stability, absence of drift, use of standard parts, low cost, and the fact that no high-gain d.c. amplifier is necessary. The circuit is shown which includes photronic cells as a part of a subtraction network. The separate beams which are produced when light is reflected to a 90° mirror beam-splitter are incident on these cells and departures from equal illumination on the two cells are registered as a voltage difference at the network terminals. The latter is recorded by means of a Brown strip-chart recorder and also drives the potentiometer slide wire contactor to select a voltage which, after reduction, is returned to a subtractor net in the galvanometer circuit. Thus, the signal across the galvanometer is always the difference between the thermopile radiation signal and the signal selected by the pen motor from the slide wire and the system is a continuous self-balancing null device. Some characteristics of the circuit are discussed and a circuit diagram and typical record are shown.

660 A New Calculation of Isotope Shift (Novyĭ Podshchet Isotopicheskogo Smeshcheniya) by D D Ivanenko and A F Tsander Zhur Eksptl Teoret Fiz 18 434-437 (1948) May (In Russian)

The isotope shift of spectral lines has been attributed to the finite dimensions of the nucleus since the inverse square law is applicable only to a point nucleus. However, the calculations of previous authors (Rosenthal and Breit Phy Rev 41 459 (1932); Smorodinskiĭ J. Phys 10 419 (1946) result in shift values deviating considerably from those observed. The present authors propose to avoid the use of the perturbation method and start with the calculation of electronic functions for interactions between an electron and a nucleus having a finite radius. The Dirac equation is solved for the electron in two regions, one inside the sphere determined by the radius of the nucleus ($r \leqslant a$), the other outside of it ($r \geqslant a$). The functions obtained, inner and outer, are than equalized for the case $r = a$. Positive corrections Δn of the quantum number are thus obtained and, finally, the values of the shift ΔE. The authors give as an example the value 10% for an isotope shift of mercury ($Z = 80$, $n = 6$). This value lies between that obtained by Rosenthal and Breit and that given by Smorodinskiĭ. As a further application of the method, the computation of probabilities of the K-capture is mentioned. These probabilities are lower than those calculated for a point nucleus.

661 On a New Recording Microphotometer Permitting Direct Intensity Measurements (Sur un Nouveau Modele de Microphotomètre Enregistreur à Lecture Directe de l'Intensité) by Marius Laffineur Compt Rend 227 900-902 (1948) Nov 3 (In French)

A device is described which eliminates some of the lengthy manipulations of photographic spectrometry. A photographic plate with both the spectrum being studied and a control spectrum is used, the latter being shaded down in the direction of its lines. After passing through rotating perforated discs, two light beams are sent through corresponding points of the two spectra, after which they re-unite on a photoelectric cell. The illumination thus produced is modulated whenever the two beams are of unequal intensity. Equality is obtained by the addition of the light of a spot galvanometer to the beam passing through the control spectrum. The current in the galvanometer originates in the photoelectric cell, and the spotlight is automatically deflected along the shaded spectral line until the

SPECTROSCOPY (continued)

equality of the intensities of the two beams is reached. The resulting equilibrium beam traces on photographic paper the intensity curve of the unknown spectrum. A diagram is given of the general arrangement of the working units of the device.

662 Soft X-Ray K Emission and Absorption Spectra of Sodium-Halides and their Ultra-Violet Absorption Bands by K Das Gupta Science and Culture 14 124 (1948) Sept

Emission spectra from the K valence band of sodium in its halides, i.e., NaF, NaCl, NaBr, and NaI, have been observed by using a bent Gypsum crystal in a vacuum spectrograph. The spectra correspond to the transition of 3 S,P electrons surrounding the halogen ion to the K level of the sodium atom. The band widths were found to increase from the fluoride to the iodide. The values obtained for the emission and absorption spectra and ultra-violet absorption bands for the sodium halides are presented in tabular form. A more detailed account of this work will be given later, in which schematic diagrams of the valence electron energy levels in NaCl and KCl will be included.

663 A Vacuum Spectrograph for the Infra-Red by Richard M Badger, Lloyd R Zumwalt, and Paul A Giguère Rev Sci Instruments 19 861-865 (1948) Dec

A description is given of a 1-meter focus vacuum grating spectrometer for the infra-red which is distinguished by its versatility and compactness of design. The vacuum container is tabular in form and all optical parts are mounted on a carriage which is readily retractable from the case for adjustment. A novel feature is the use of a sine screw drive which gives a linear wave-length scale. A representative spectrum tracing is given.

TRACER APPLICATIONS - BIOLOGY

664 Symposium on Radioiodine, July 28-30 1948. AECU-51 (BNL-C-5) nd 118p

The following papers were presented: Radioactive Iodine: Its Use in Studying Certain Functions of Thyroid Tumors, by Rulon W. Rawson; The Biological Effect of Irradiation by Radioactive Iodine, by Bengt N. Skanse; The Mechanism of Action of Anti-thyroid Drugs, by Malcolm M. Stanley; Turnover Rates as Measured by Radioiodine, by William T. Salter, MacAllister Johnston, and John Gemmel; Standardization of Radioactive Iodine, by Sergei Feitelberg; Calculation of Dosage in Radioiodine Therapy, by Edith H. Quimby; Uptake and Excretion Measurements and Their Significance by Eleanor Oshry and Charlotte Schmidt; The Radiation Treatment of Hyperthyroidism, by F. M. Chapman; Graves' Disease: Treatment with Radioiodine I^{131}, by Mayo H. Soley, Earl R. Miller, and Nadine Foreman; Indicator of Thyroid Function in Man, by Widney C. Werner, Edith H. Quimby, and Charlotte Schmidt; Histologic Types of Thyroid Carcinoma and Their Respective Abilities to Store Radioactive Iodine^{131} as Demonstrated by Radioautograms, by Patrick J. Fitzgerald; Radioautographs: Methods and Uses, by Titus C. Evans; Studies on Dosage in Cancer Therapy, by L. D. Marinelli and Ruth F. Hill; Clinical Methods and Results of Radioiodine Therapy in Metastatic Thyroid Cancer, by S. M. Seidlin; I^{131} as a Therapeutic Agent in Cancer of the Thyroid, by J. B. Trunnell.

665 Assimilation of Tracer Carbon in the Alga Scenedesmus by A H Brown, E W Fager and H Gaffron Arch Biochem 19 407-428 (1948) Dec

With radioactive C^{14} as a tracer, the fixation of carbon dioxide in the dark and its assimilation in the light was followed by manometric and chemical means in the alga Scenedesmus. Upon separation of the cellular constituents into 3 fractions, water-soluble, benzene-soluble, and insoluble, it was found that the water-soluble fraction, containing less than 2% of the dry weight of the algae, always had the greatest activity in terms of counts/mg of sample. Kinetic studies showed that this fraction, ($B_{(dark)}$ or $B_{(light)}$), respectively, was the first to appear at the beginning of any fixation or assimilation period. $B_{(dark)}$ can be formed under anaerobic conditions but, in the presence of air, it is rapidly respired and transformed into other compounds. $B_{(light)}$ is stable against metabolic attack in the non-illuminated cell, but is transformed photochemically into the other fractions, slowly in the absence of carbon dioxide, rapidly in the presence of carbon dioxide. Kinetic studies, as well as the photosensitivity of

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$B_{(light)}$, make it preferable to consider it as the first stable intermediate rather than as the first product of photosynthesis. A comparison between the rates and total amounts of light and dark fixation of tracer carbon dioxide and the properties of the substances resulting from these fixations provides no support for the existence in measurable quantity of a stable dark fixation product identifiable as a precursor to the photochemical reduction of carbon dioxide. It appears possible that $B_{(light)}$ may combine in one molecule the properties of an intermediate in the reduction process and those of a carbon dioxide acceptor. Those dark fixation products which have been isolated by our methods have either an indirect relation to photosynthesis or none at all. 9 references, 10 figures, and 4 tables.

666 Blood Volume Determination in the Human with Red Cells Containing Radioactive Phosphorus (P^{32}) and with Pure Human Albumin by Frank J Kelly, Donald H Simonsen and Robert Elman J Clin Invest 27 795-804 (1948) Nov

The blood volume was determined in normal human subjects and in patients with chronic hypoproteinemia by using red blood cells labeled with radioactive phosphorus (P^{32}). The method consisted of incubating a small sample of the subject's blood with an isotonic solution containing approximately 50 microcuries of radioactive phosphorus and reinjecting a portion of it. With this technic a direct value for the whole blood volume was obtained. The plasma and red cell volumes were than calculated by means of the hematocrit. The blood volume was also measured in five patients by using values obtained from changes in the hematocrit and plasma albumin concentration following injection of a known amount of pure salt-poor albumin. When compared with the simultaneous determinations made with radioactive red cells, the former method gave higher results for initial plasma volume, but subsequent changes checked well. Both methods proved relatively simple and would seem to be well adapted to clinical investigation. The findings were in close agreement with those obtained by other investigators using similar and other methods. 44 references.

667 Effect of Amino Acid Deficiencies on Incorporation of Radioactive Carbon-Labeled Amino Acids into Animal Tissue Proteins by D R Sanadi and D M Greenberg Proc Soc Exptl Biol and Med 69 162-163 (1948) Oct

Rats and mice raised on a diet deficient in an essential amino acid (tryptophane, phenylalanine) showed a reduced incorporation of tracer amounts of C^{14} from labeled amino acids in the tissue proteins.

668 The Leakage of Radioactive Potassium from Stimulated Nerve by R D Keynes J Physiol 107 35P-36P (1948) Sept 30 (in the section of Proc Physiolog Soc (1948) Mar 20)

Carcinus nerves were soaked for several hours in Ringer containing K^{42}, until they had taken up an appreciable amount of the radioactive ions. The nerve was then mounted in a thin-bottomed chamber over a Geiger counter, with its ends pulled up into a layer of paraffin oil so that stimuli could be applied and the action potentials recorded. The central part of the nerve was held down by glass hooks, and inactive Ringer was circulated continuously around it so that K^{42} ions did not contribute to the recorded radioactivity once they had leaked out. Under resting conditions the amount of K^{42} in the fibers then decreased exponentially, with an average half-time of 1.4 hr. for whole nerve, and 1.9 hr. for isolated 30 fibers.

When the nerve was stimulated at 17 impulses/sec., the rate of loss of K^{42} was roughly tripled. In normal Ringer this might have been due either to an increased rate of exchange of K^+ ions, with no net loss of K, or to an actual leakage of K during stimulation. The fact that the same increased loss of K^{42} occurred in K-free Ringer, where there could be no exchange, suggested that there was a net leakage of K. This was confirmed by comparing the rates of entry of K^{42} into resting and stimulated fibers; at 50 impulses/sec. the rate was only increased to 1.3 times its resting value, whereas the corresponding increase in rate of leakage would be about 10 times.

The total amount of K inside the fibers which could exchange with K^{42} was found to be 206 mmol./liter axoplasm. Hence the amount of K lost during stimulation was calculated to be 2.1×10^{-12} mol./cm^2 membrane/impulse. This is comparable with the figure of 1.7×10^{-12} mol./cm^2/impulse

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obtained by Hodgkin and Huxley (J Physiol 106 341 (1947)) for the same type of nerve by an indirect method, and supports the supposition that K does leak out during activity.

669 Metabolism of C^{14}-labeled Urea by Edgar Leifer, Lloyd J Roth, and Louis H Hempelmann Science 108 748 (1948) Dec 31

C^{14}-labeled urea was synthesized, and its gross metabolism studied in a series of mice in order to determine the fate of the carbon in the urea molecule. The urine was analyzed by using filter paper chromatography and radioautographs of the paper strip. The exhaled CO_2 was absorbed in 20% NaOH. The carbonate formed was converted to $BaCO_3$ for radioactivity determination. Results indicate that 20.8% of the injected C^{14} in urea appears in the exhaled CO_2. The mechanism of the CO_2 formation has not been established, but the very rapid initial excretion of radioactive CO_2 indicates that a large per cent of urea is degraded in the first 3 hours. The kidneys contained 2 or 3 times the amount of radioactivity of the other tissues tested, probably because of the concentrating action of the tubules.

670 Radioactive Isotopes (Los Isotopos Radiactivos) by Domingo Pescuma La Semana Médica 15 No.2853 564-568 (1948) Sept 16 (In Spanish) (See also NSA 1331)

This is a general review of the use of radioactive isotopes as tracers and diagnostic aids, and of some of the hematological complications resulting from their use. A chronology of the discoveries in radioactivity is also given.

671 Radioactive Isotopes in Biology (Les isotopes radioactifs en biologie) by Lucien Perruche La Nature No.3162 308-309 (1948) Oct (In French)

This is a short and admittedly incomplete review of the subject. From 1 to 3 sentences are given to such subjects as discovery, preparation, kinds, numbers, and various research possibilities of the isotopes. P^{32}, I^{131}, Fe^{59}, Na^{24}, Br^{82}, K^{42}, C^{11}, and C^{14} are mentioned specifically.

672 Radioactive Isotopes in Surgery by M D Chesler Surgical Staff Seminars, Minneapolis Veterans Hospital 5 No.3 27-50 (1948) Aug 10

This review of literature on the use, mainly in surgery, of radioisotopes is divided into the following sections: I Physical Background; II Sodium; III Phosphorus; IV Iodine; V Calcium and Strontium; VI Body Water and Solids; VII Di-azo Dyes; VIII Other Interesting Studies; IX Hazards; X Summary; 49 references.

673 Studies of Phosphorus Metabolism in Man: II. A Study of the Permeability of the Human Erythrocyte to Inorganic Phosphate in Vitro by the Use of Radioactive Phosphate (P^{32}) by F H L Taylor, S M Levenson, and M A Adams Blood 3 1472-1477 (1948) Dec

The phosphate exchange in red cells and plasma was studied in vitro using P^{32} in the form of sodium phosphate as a tracer. No phosphate was added other than the isotopic preparation of high specific activity. The inorganic phosphate exchanged freely between the plasma and the erythrocytes at 37.5°C in a period of four hours. The minimal transfer occurred at 7°C. Most of the added P^{32} which passed into the erythrocytes during this time remained in the inorganic fraction; less than 15% was found in the organic acid soluble fraction. The specific activity of the inorganic phosphate of the erythrocytes was equal to or greater than that obtained for the inorganic phosphate of the plasma at the end of the four-hour incubation period at 37.5°C. 8 references. 2 tables.

TRACER APPLICATIONS - CHEMISTRY

674 Some Mechanism Studies on the Fischer-Tropsch Synthesis Using C^{14} by J T Kummer, T W DeWitt and P H Emmett J Amer Chem Soc 70 3632-3643 (1948) Nov

The theory that metallic carbide is an intermediate in the synthesis of hydrocarbons from carbon monoxide and hydrogen over the catalysts, iron, nickel, and cobalt, has been tested by using C^{14} as a tracer. It was seen that only about 10% of the hydrocarbon product was formed through the carbide intermediate at or below 260° for iron, at or below 200° for cobalt. This percentage averages about

TRACER APPLICATIONS - CHEMISTRY (continued)

16 at 300°. The percentages are not critically dependent on the hydrogen:carbon monoxide ratio in the range 1:1 to 3:1 total pressure in the range 150-800 mm, or the percentage of carbide initially present. The carbon monoxide exchange with the carbon in the carbide is only about 5% in 30 minutes at 250° but 29% in 7 minutes at 322°.

TRACER APPLICATIONS - INDUSTRY

675 Industrial Uses of Radioisotopes by G H Guest. National Research Council of Canada Atomic Energy Project Report CRIB-399 Dec 1948 27p

Suggested uses of isotopes are indicated by 37 examples collected from bulletins, reports and scientific journals. In addition 31 industrial uses are listed in a group extracted from Appendix I of the Fourth Semi-Annual Report of the United States Atomic Energy Commission.

TRACER APPLICATIONS - PHYSICS

676 Measurement by Radioactive Tracers of Diffusion in Liquids by Andrew Gemant J Applied Phy 19 1160-1163 (1948) Dec

A method, using a radioactive tracer technique, for the measurement of diffusion coefficients in liquid is described. In this method the pure solvent is confined within an inert porous structure with which the solution is in direct contact. Bonded fiberglass mat was found suitable for such a porous structure (3-volume percent of glass); in some tests agar gel was used instead. Results for uranyl nitrate solutions, revealing the diffusion of Th-234, in water and dioxane are presented.

TRANSURANIC ELEMENTS

677 The Absorption Spectra of Plutonium Ions in Aqueous Solution by R H Betts and B G Harvey. National Research Council of Canada Report CRC-390 Oct 1 1948 23p

The absorption spectra of Pu(III), Pu(IV) and Pu(VI) have been investigated in solutions containing various strong acids. The Pu(IV) ion was found to obey Beer's Law in 3N nitric acid solution. The vibrational spectrum of the PuO_2^{++} ion has been observed in acid solutions. The presence of Pu(IV) and Pu(V) in mixtures of Pu(III) and Pu(VI) in dilute hydrochloric acid has been observed.

678 Missing Elements, Atomic Weights, Electron Deficient Molecules, Transuranic Elements by R E Dodd and P L Robinson Ann Reports Pro Chem (1947) 44 50-60

The authors review the work that has been done on the missing elements, atomic weights, electron deficient molecules, and the trans-uranium elements. The work involved in the discovery and properties of elements 43, 61, 85, 87, 93-96 and summarized by Paneth (Nature 159 8 (1947)) is very briefly discussed. Fifteen references are given in connection with this field. Under the subject heading of electron-deficient molecules, a discussion of the structural character of the borohydrides of lithium, beryllium, and aluminum, and the hydrides of gallium, indium, thallium, and aluminum are of particular interest. Twenty-three references are given on this subject. It has been suggested that the rare earths be called lanthanons and the trans-uranium elements, actinons. The separation and isolation of lanthanons is reviewed and literature references are given. The study of element 61 is particularly emphasized. It may be produced artificially from the stable neodymium isotope 60 Nd^{146} or as the result of the β-decay of the nucleus 60 Nd^{147} (which occurs as 2.6% of the fission products of U^{235}. A review with references on the chemistry of trans-uranic elements is presented.

URANIUM

679 U-234 Specific Alpha Activity by G B Knight, A S Goldin and P A Macklin. AECU-43 (K-317) Dec 8 1948 15p

The half-life, specific activity, decay constant and fraction in natural uranium of U-234 have been redetermined by a radioactive growth method. A pure sample of U-234 was prepared by decay of isolated UX_1 (Th-234) and its alpha activity was measured and compared with the specific activity of

URANIUM (continued)

pure U-238. The values obtained are estimated to be accurate to 1.3%, but differ by more than this percentage from other values based on mass spectrometer data.

680 Fluorescence Spectra of Uranyl Salts at the Temperature of Liquid Hydrogen; Existence of a Difference of about 12 cm^{-1} (Spectres de fluorescence de sels d'uranyle à la température de l'hydrogène liquide; existence d'une fréquence 12 cm^{-1} environ) by Marie Freymann and René Freymann Compt Rend 227 1096-1098 (1948) Nov 22 (In French)

Continuing their study of the fluorescence and absorption spectra of uranyl salts at low temperatures (Compt Rend 226 1029 (1948)), the authors give the results of observations made at the temperature of liquid hydrogen (-253°C). The compounds studied were uranyl nitrate and uranyl acetate. A frequently occurring difference of about 12 cm^{-1} was added to those observed previously.

681 On the Fluorescence Spectra of Certain Organic Uranyl Nitrate Compounds (Sur les spectres de fluorescence de quelques combinaisons organiques du nitrate d'uranyle) by Marie Freymann and Henri Chantrel Compt Rend 227 1029-1031 (1948) Nov 15 (In French)

Fluoresence spectra are given of uranyl nitrate and of its compounds with acetone, ether, and dioxane; the observations were made at the temperature of liquid air. The data confirm the classification of the fluorescence spectra of uranyl salts which has been previously suggested by the authors (Compt Rend 223 543 and 573 (1946); 225 529 (1947); 226 332 (1948)).

682 Rarer Elements in Qualitative Analysis. II: Uranium by Ting-Ping Chao and Shih-Chia Chen J Chem Education 25 686-687 (1948) Dec

In order to include uranium in the elementary course of qualitative analysis, the authors have devised a method by which the regular system of analysis may be used for identification of the element. Uranium falls in the aluminum division of group III and a procedure for separation and identification is given.

683 The Spectral Analysis of Uranium Oxide by R Breckpot Congrès du Groupement pour l'Avancement des Méthodes d'Analyse Spectrographique des Produits Métallurgioues (Paris) 8 33 (1947)

The author conducted a study investigating the conditions for the preferential excitation of impurity lines of U and other refractory elements. The compounds In_2O_3 and AgCl gave best results when used as entrainment agents in the fractional sublimations. The selective excitation method in presence of alkaline salts was studied, and it was seen that even when the uranium spectrum is suppressed, the elements Mo, Pb, Bi, and several other elements are sharply brought out. The method is not applicable to Cb, Ta, and W, but was extended to Th and La.

VACUUM

684 A Combined Thermocouple and Cold-cathode Vacuum Gauge by R I Garrod and K A Gross J Sci Instruments 25 378-383 (1948) Nov

The design, construction, and performance of a vacuum gage covering the range 10^{-1} to 10^{-5} mm of mercury are described. The gage consists essentially of two elements in a common envelope, a thermocouple gage for pressure measurements in the range 10^{-1} to 10^{-3} mm, and a cold-cathode discharge gage for pressures below 10^{-3} mm. A simple means for initiating the discharge in the latter gage at low pressures is included. Assembly and circuit diagrams are shown. Design data for optimum performance of each element are discussed, along with the cause of the "reversal effect," common in thermocouple gages.

VACUUM (continued)

685 Scientific Aspects of Vacuum Technique by Saul Dushman Chem and Ind 41 S.3-S.8 (1948) Oct 9

The author reviews the development, importance, and well known principles of vacuum techniques and vacuum pumps in a general way. Consideration is also given to manometers, leak detectors, and getters used in high vacuum applications. 31 references.

686 Vacuum Fittings by C C Lauritsen and T Lauritsen Rev of Sci Instruments 19 919-920 (1948) Dec

Several devices found useful in connection with kinetic vacuum systems which have been developed using variations of the techniques recently described by Kurie (Rev Sci Instruments 19 485 (1948)) are discussed. These include the following: (1) a tubing joint which has been found convenient and reliable for tube diameters of one inch to one foot; (2) two sliding or rotating seals, one of which is particularly adapted for thin-walled vacuum chambers; (3) a device consisting of a brass cup and quartz disk which acts as a Faraday cage and beam trimmer, and which is adapted for locating, measuring and trimming an ion beam.

X-RAYS

687 Thick-Target X-ray Production in the Range from 1250 to 2350 Kilovolts by W W Buechner, R J Van de Graaff, E A Burrill and A Sperduto Phys Rev 74 1348-1352 (1948) Nov 15

An experimental investigation has been made of the thick-target production of x-rays by electrons from an electrostatic accelerator. Measurements were made with an ionization chamber for targets of beryllium, aluminum, copper, silver, tungsten, and gold. Various voltages from 1250 to 2350 kilovolts were used, and the angular range covered was from 0 to 140 degrees. Curves of x-ray intensity as a function of angle at various voltages are shown for the various targets. The total radiation intensity, integrated over all angles, is found to be accurately linear with atomic number in this energy range. From these measurements, the efficiency of x-ray production has been calculated. For the case of 2.35-million-volt electrons on gold, a value of 7.4 percent is obtained. This is in adequate agreement with theoretical predictions.

688 X-ray Screen by William H Byler, Morris Plains and Clayton C Carroll, Madison, N. J., assignors to United States Radium Corporation, New York, N. Y. U S Patent No. 2,454,499 Nov 23 1948

The authors claim to have developed a luminous material containing no nickel, which gives the required low phosphorescence, good definition, and contrast. The material consists of zinc and cadmium sulfides, together with silver and, in some instances, gold, copper, or manganese. The range for CdS is between 38% and 70%, for Ag from 1 part per 3000 to 1 part per 100,000. Cu or Au must not be used in a greater proportion than 1 part per 100,000, while Mn is limited to 1 part per 10,000. The dominant wave length of the emission from the material is in the range of 559 to 618 millimicrons.